Gary G. [illegible]

AN 01-85FGF-1

# Flight Handbook

## *NAVY MODEL*

## F9F-8
## AIRCRAFT

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE
AND THE CHIEF OF THE BUREAU OF AERONAUTICS

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*1 August 1954*

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# TABLE OF CONTENTS

# IMPORTANT

*To gain the maximum benefits from this handbook it is imperative that you read this page carefully.*

## FOREWORD

The function of this flight handbook is to acquaint the pilot with the airplane, furnishing information necessary for normal and emergency flight. All operating procedures in this book are either based on actual F9F-8 flight tests or are based on F9F-6 flight tests which are estimated to be valid for the F9F-8 airplane.

It is most important that the pilot keep abreast of all pertinent technical directives which may have been issued since the publication of this handbook, but which may not yet have been incorporated in the form of handbook revisions.

The pilot's flying experience is recognized; these instructions are not intended to teach the basic principles of flight, but are designed to provide the pilot with a general knowledge of the airplane.

This handbook is divided into sections as follows:

SECTION I, DESCRIPTION. This section describes the airplane and its systems and controls which contribute to the physical act of flying the airplane. Also included is emergency equipment which is not part of an emergency system.

SECTION II, NORMAL PROCEDURES. Included in this section are the procedures to be followed on a non-tactical flight under normal conditions, from the time the pilot approaches the airplane until the flight is completed and the airplane is left parked on the ramp.

SECTION III, EMERGENCY PROCEDURES. The procedures to be followed in meeting any emergency that the pilot could reasonably expect to encounter, except those in connection with auxiliary equipment, are described in this section.

SECTION IV, DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT. This section includes description, normal operation and emergency operation of all equipment not directly contributing to flight but which enables the airplane to perform specialized functions.

SECTION V, OPERATING LIMITATIONS. All important limitations which must be observed during normal operation of the airplane are covered in this section. This section is incorporated in the supplement to this handbook, CO 01-85FGF-1A.

SECTION VI, FLIGHT CHARACTERISTICS. This section describes the unique characteristics of this airplane in flight. This section is incorporated in the supplement to this handbook, CO 01-85FGF-1A.

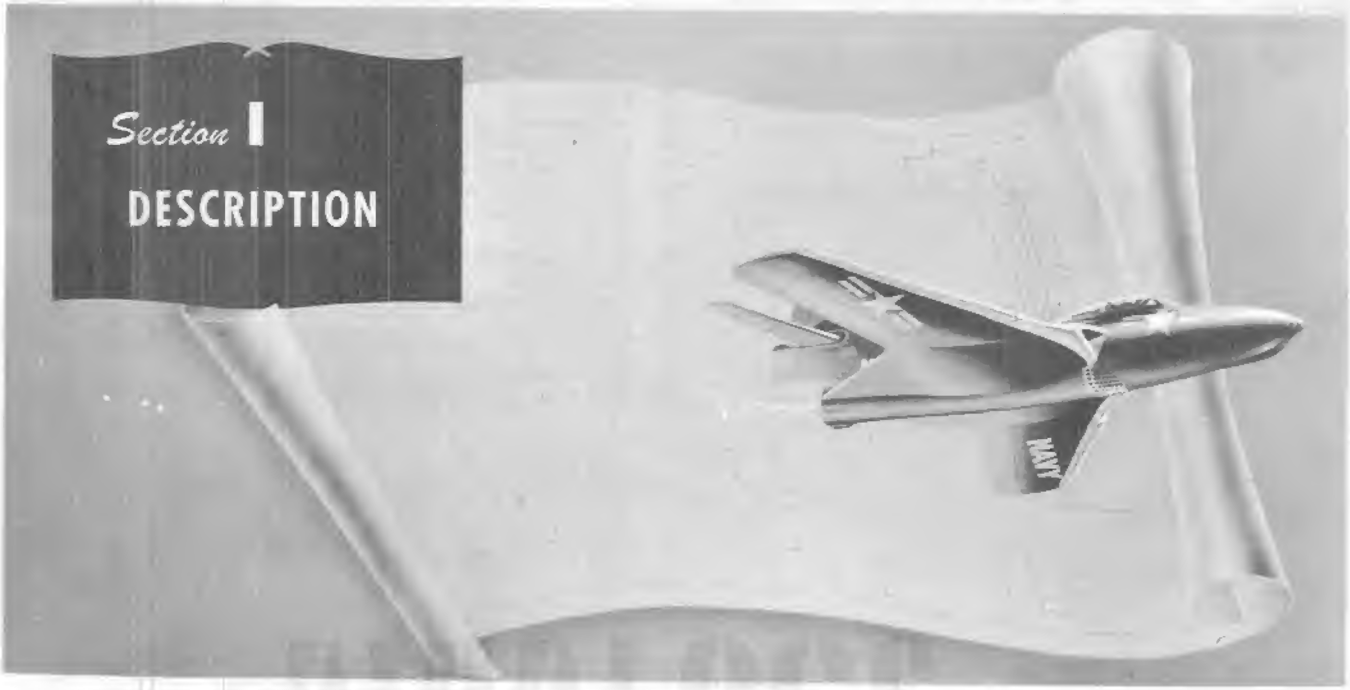
SECTION VII, SYSTEMS OPERATION. Operation of the various airplane systems under varying conditions is discussed in this section, with emphasis given to any special problems which must be considered.

SECTION VIII, CREW DUTIES. Not applicable.

SECTION IX, ALL WEATHER OPERATION. This section contains procedures to be followed under extreme climatic conditions. No repetition is made of procedures given in other sections. (This information will be supplied when available.)

APPENDIX I, OPERATING DATA. This section contains all operating data charts and tables necessary for preflight and inflight mission planning and explanatory text on the use of the data presented. This section is incorporated in the supplement to this handbook, CO 01-85FGF-1A.


*Figure 1-1. Airplane*




## AIRPLANE.

The airplane is a single place, single jet engine fighter, which has a flying tail and swept wings with cambered leading edges, built by the Grumman Aircraft Engineering Corporation. It is designed primarily for aircraft carrier operations and is equipped with folding wings and arresting gear.

Rudder control on this airplane is conventional. In the landing configuration, longitudinal control is attained in the conventional manner. In the clean configuration, the airplane is controlled longitudinally by a hydraulic powered, all movable horizontal stabilizer (flying tail). Lateral control is accomplished by hydraulically operated flaperons.

The maximum recommended gross weight for this airplane is 22500 pounds for field take-off and 18500 pounds for field landings. Its principal dimensions are:

| | |
|---|---|
| Span | 34 ft 6 in. |
| Span (wings folded) | 15 ft 8 in. |
| Length | 42 ft 1-1/2 in. |
| Height | 12 ft 3 in. |
| Height (wings folded) | 15 ft 6-3/8 in. |

## ENGINE.

The J48-P-8 engine is of the centrifugal flow, turbo jet type. It is equipped with a fuel boost pump, two main fuel pumps and a fuel control unit. The fuel control unit automatically adjusts itself to engine speed and altitude changes.

### ENGINE FUEL CONTROL SYSTEM.

The engine fuel system consists of an engine driven fuel boost pump, a low pressure filter, two engine driven high pressure fuel pumps, a Holley fuel control unit, and a fuel pressurizing and shut-off valve. The Holley fuel control unit provides rapid, controlled acceleration within tailpipe temperature limitations, and also limits deceleration rates to prevent flame-out. The fuel control unit includes temperature and pressure units designed to maintain proper rate of fuel flow during changes in airplane speed and altitude. Transfer from the primary (normal operating) fuel system to the emergency fuel system in case of failure of the primary system is accomplished by setting the engine fuel system selector switch to its emergency position. A red warning light is installed to warn the pilot of failure of either of the main pumps.

#### NORMAL OPERATION.

In normal operation, fuel from the front tank flows through the engine driven boost pump and filter to the main pumps A common tube joining these pumps leads fuel to the control unit. Fuel leaves the control unit through one side of a double ball check valve and is routed through a pressurizing and shut-off valve to the combustion chambers. At low engine speed, this valve supplies fuel to the central swirl passage in each nozzle through a pilot manifold. As engine speed and consequent pump pressure increase, the pressurizing valve opens progressively, until at maximum rpm, the valve is fully open and the nozzles receive the bulk of their fuel supply from the main fuel manifold. The

# GENERAL ARRANGEMENT and

1. Gun Ranging Radar Antenna (Installed on Airplanes without In-flight Refueling Probe)
2. Radio Compass Loop Antenna
3. 20mm Guns
4. Battery
5. Ammunition Boxes
6. Gun Ranging Radar Antenna (Installed on Airplanes with In-flight Refueling Probe)
7. Brake System Hydraulic Reservoir
8. Circuit Breaker Panel
9. Gun Sight Unit
10. Fuse Panel
11. Air Conditioning Turbine Oil Filler Port
12. Radio Compass Sense Antenna
13. Forward Fuel Tank Fillerneck
14. Aft Fuel Tank Fillerneck
15. Upper Hydraulic Reservoir and Fillerneck
16. Engine Oil Fillerneck
17. Flaperette Hydraulic Reservoir and Fillerneck
18. Engine
19. Leading Edge Fuel Tank (Part of Wing Tank) L/R
20. D-C External Power Receptacles
21. Wing Tank Pressure Fueling Valve L/R
22. Wing Tank Fillerneck L/R
23. Lower Hydraulic Reservoir (Filled from Upper Reservoir Fillerneck)
24. Droppable Tank or External Stores L/R
25. IFF Antenna
26. Pressure Fueling Valve
27. Oxygen Bottles
28. A-C External Power Receptacle
29. UHF Command Set Blade Antenna
30. UHF Homing Adapter Antenna

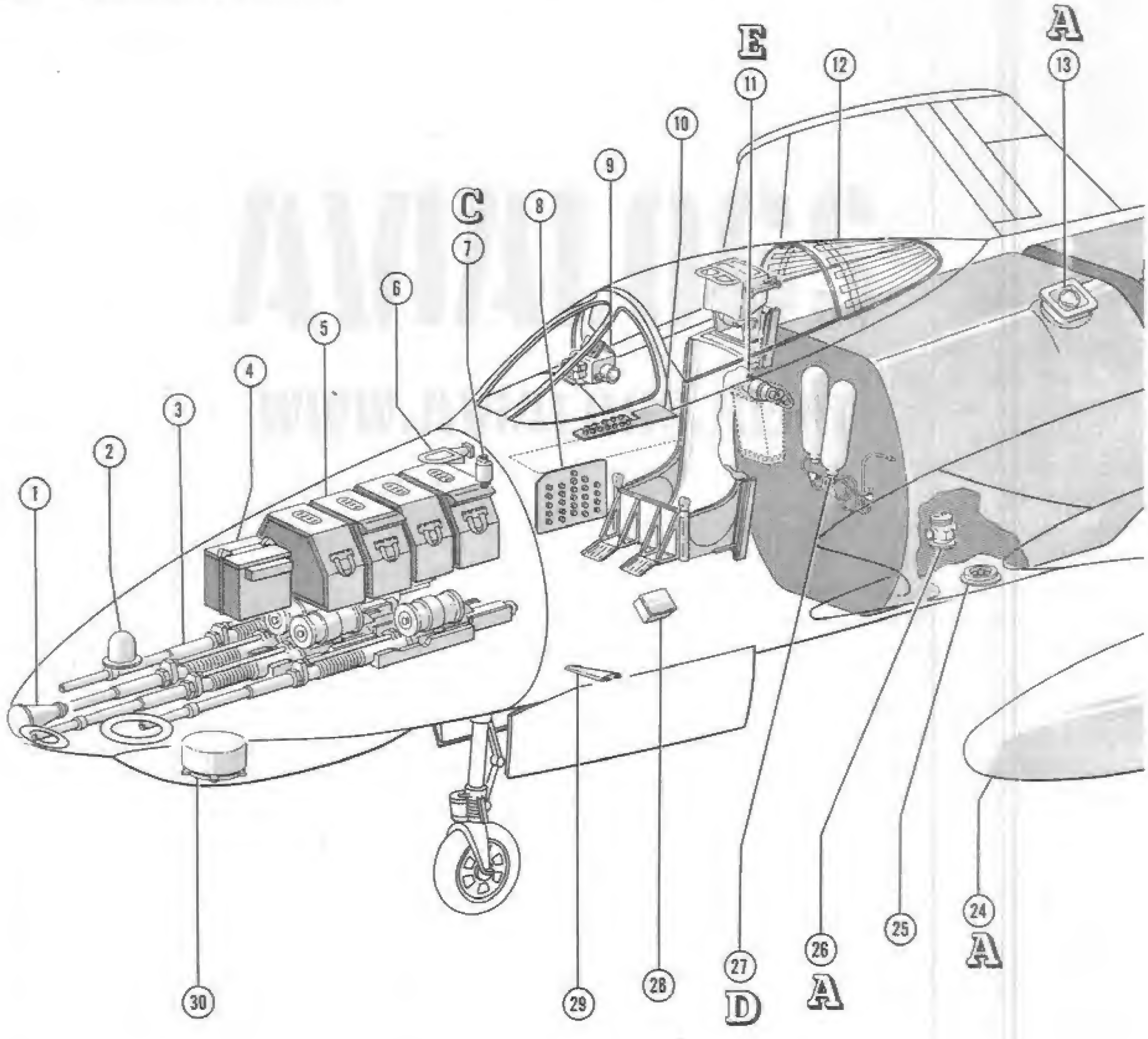
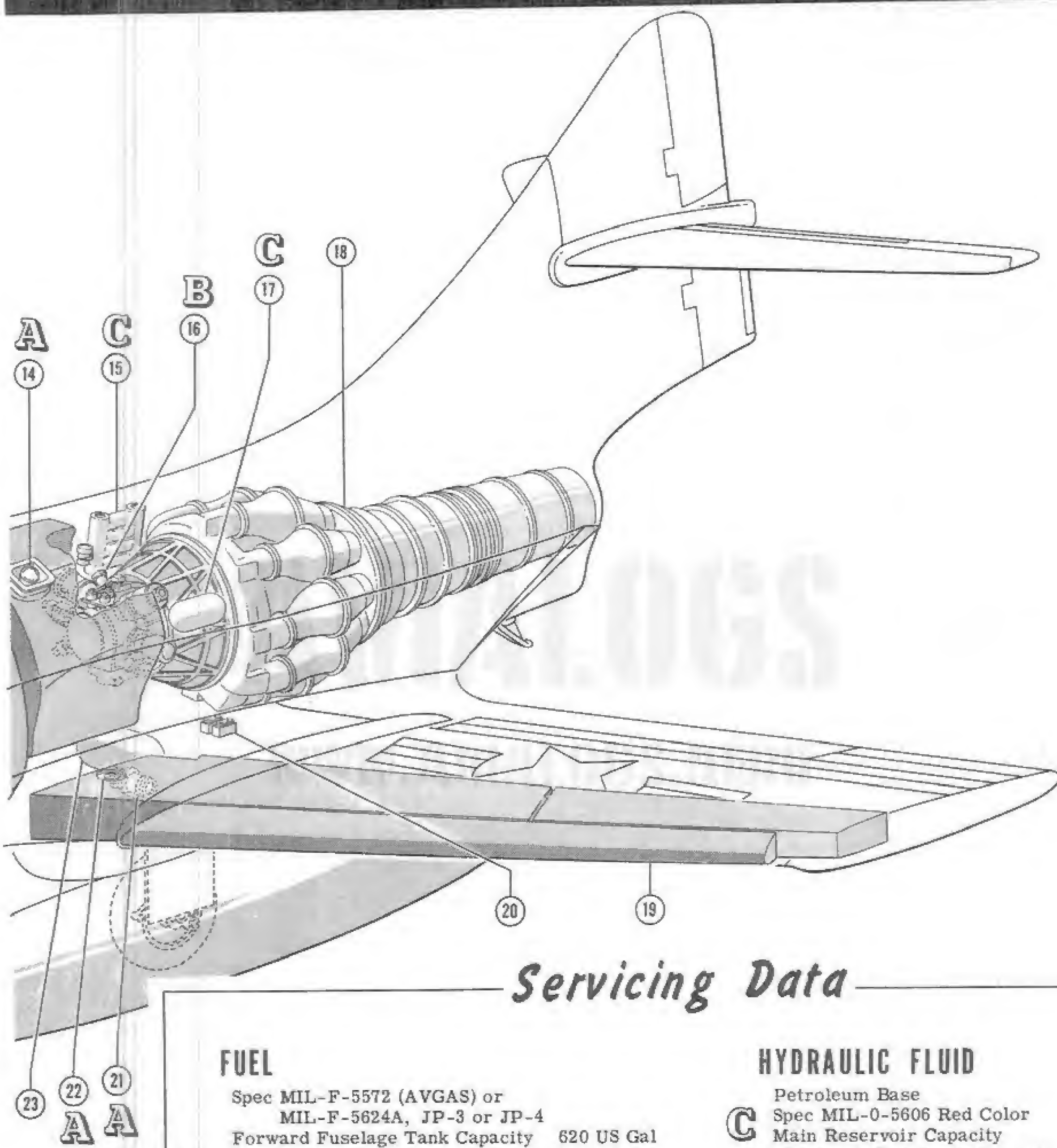



*Figure 1-2. General Arrangement and Servicing Diagram (Sheet 1 of 2)*

# SERVICING DATA




## Servicing Data

### FUEL

Spec MIL-F-5572 (AVGAS) or
MIL-F-5624A, JP-3 or JP-4

| | | |
|---|---|---|
| A | Forward Fuselage Tank Capacity | 620 US Gal |
| | Aft Fuselage Tank Capacity | 240 US Gal |
| | Left Wing Tanks Capacity | 103 US Gal |
| | Right Wing Tanks Capacity | 103 US Gal |
| | Left External Aux Tank Capacity | 150 US Gal |
| | Right External Aux Tank Capacity | 150 US Gal |

### OIL

B Spec MIL-0-6081 Grade 1010
Tank Capacity 13 US Quarts.

### HYDRAULIC FLUID

C Petroleum Base
Spec MIL-0-5606 Red Color

| | |
|---|---|
| Main Reservoir Capacity | 6 US Gal |
| Flaperette Reservoir Capacity | 1.8 US Gal |

### OXYGEN

D Pressure 1800±50 psi

### COOLING TURBINE OIL

E Spec MIL-0-6085
Fill to bottom surface of port.

*Figure 1-2. General Arrangement and Servicing Diagram (Sheet 2 of 2)*

shut-off valve is opened by the throttle linkage when the latter is moved from START to IDLE.

EMERGENCY OPERATION.

Operation of the emergency fuel system is initiated by the pilot setting the engine fuel system selector switch to its emergency position. When a changeover to emergency is made, the amber warning light on the fuel control panel will glow; a normally open valve in the primary system will close, while a normally closed valve in the emergency system will open, directing fuel through the emergency control. When operating on the emergency system, there is no automatic acceleration or deceleration control or temperature or density compensation, and the pilot must operate the throttle carefully to avoid overspeeding or overheating the engine. During emergency operation, the engine high pressure pumps are isolated from the fuel control hydraulically and are therefore at their maximum pressure output.

**ENGINE FUEL SYSTEM CONTROLS.**

FUEL MASTER SWITCH.

This toggle switch (39, figure 1-5), equipped with a guard, is located on the right console electrical control panel, outboard. When set to ON, it energizes the submerged low pressure fuel boost pump in the bottom of the front tank and opens the valve in the feed line to pump fuel to the engine. When the switch is set to OFF, the valve is closed and pump operation is stopped.

**CAUTION**

This switch MUST BE ON whenever the engine is running. If the switch is set at OFF, fuel feed will shut off, possibly causing line collapse and fuel line trouble and, since the engine fuel pumps have no dry rating, eventual pump failure. This switch must not be set to OFF until the throttle is moved to CLOSED and the engine has stopped rotating.

ENGINE FUEL SYSTEM SELECTOR SWITCH.

This three position toggle switch (41, figure 1-3) is on the fuel control panel on the left console. The three positions are forward (momentary) — RESET PRIMARY, center—START & PRIMARY, and aft—EMER. Setting the switch to START & PRIMARY permits starting the engine and operating on the primary (automatic fuel control) fuel system. Setting the switch to EMER. controls the changeover from the primary fuel system to the emergency fuel system.

**Note**

Ground or airstarts may be made with the switch set to EMER. as well as at START & PRIMARY.

When operating on the emergency system, the fuel control is manually regulated by the throttle. The amber warning light on the panel glows with this switch setting (the light glows only when transfer to the emergency system has been completed). When the switch is set to RESET PRIMARY and held momentarily before being set to START & PRIMARY, the fuel control system is reset to normal operation (on the primary system) after operating on the emergency system.

**CAUTION**

This switch should be set at EMER. only for actual emergency conditions, as this setting places very severe requirements on the main pumps.

FUEL SYSTEM BOOST PUMP CUT-OFF SWITCH.

This push button switch (40, figure 1-3) is on the fuel control panel on the left console. With the engine operating, pressing this button cuts out the airplane fuel system boost pump in the main fuel tank, so that the engine driven boost pump is the only source of pressure to the two engine driven high pressure fuel pumps. If pressure from this pump is below that required, the low fuel boost pressure light will glow.

THROTTLE.

The throttle lever (34, figure 1-3) is installed on the quadrant on the left console. When it is set full aft and inboard at the CLOSED position, the engine is shut down, the high pressure cock is closed and the ignition is off. When the engine start master switch has been set to ON, the engine cranking switch set to START, moving the throttle lever outboard to the START position actuates a switch to supply power to the spark igniters. When it is moved forward toward the IDLE position, its linkage mechanically opens the high pressure cock, and when moved inboard past the detent and into the IDLE position, fuel is fed to the engine to operate it at the proper idle rpm. When the throttle is moved to its full open position, the engine should operate at 100% (11000 rpm).

THROTTLE FRICTION CONTROL.

A throttle friction control lever (21, figure 1-3) is installed on the inboard side of the quadrant. The lever is moved forward to increase friction on the throttle and aft to decrease it.

CATAPULT GRIP.

A catapult grip (20, figure 1-3) is installed just forward of the throttle quadrant. The grip is a spring loaded rod, normally stowed. For catapult take-off use, the tab on the top is rotated inboard, which permits pulling the grip up into position. The grip is rotated outboard and drops down to the stowed position when its use is not desired.

**ENGINE FUEL SYSTEM INDICATORS.**

ENGINE FUEL PUMPS WARNING LIGHT.

A red warning light (42, figure 1-3) for the two engine driven (high pressure) fuel pumps is on the fuel control panel on the left console. The light glows to indicate failure of either pump.

EMERGENCY FUEL SYSTEM INDICATOR LIGHT.

This amber warning light (39, figure 1-3) glows when the engine is operating on the emergency fuel system. It is located on the fuel control panel on the left console.

LOW FUEL BOOST PRESSURE WARNING LIGHT.

A red warning light (2, figure 1-4) on the upper left corner of the main instrument panel glows when pressure from the airplane fuel system boost pump drops below 6 psi or when the fuel filter is blocked by ice or foreign matter. The latter condition indicates that the engine is operating on unfiltered fuel. Prior to engine starting, operation of the airplane fuel system (fuselage tank) boost pump may be checked by setting the fuel master switch to ON and observing that the low fuel boost pressure warning light glows momentarily and goes out, an indication that the pump has built up the required pressure. While the engine is running, the engine driven boost pump may be checked by depressing the fuel boost pump cut-off switch button and observing that the low fuel boost pressure warning light does not glow, an indication that this pump is holding the required pressure above 6 psi. "Light out" condition on both of these checks also indicates that the filter is operating normally and is not clogged.

**Note**

The use of a single light for the dual purpose described does not permit identification of malfunction. It warns the pilot only of trouble in the low pressure portion of the fuel system.

**ENGINE COOLING.**

Engine cooling is accomplished by two separate automatic systems. The first system consists of a cooling air impeller mounted on the compressor shaft which receives air through the rear screen support and forces it aft to cool the center and rear bearings. Part of this air passes out radially to cool the turbine disc front face, thence into the cooling air manifold and out the cooling air duct at the fuselage bottom. The second system provides cooling air for the tailpipe. Air is drawn through three flush type ram air scoops in the tail section skin, circulates between the tailpipe and the shroud and flows out at the rear.

**IGNITION SYSTEM.**

The ignition system is used only during engine starting. When the turbine has reached sufficient speed to permit engine light-up, the two igniter plugs (in combustion chambers No. 4 and 7) are energized by the throttle quadrant limit switch. The engine start master switch must be ON in order for the ignition circuit to be operative for both ground and airstarts. The ignition system will be energized for 60 seconds after the limit switch is actuated, after which it will shut off automatically. However, when the engine start master switch is turned OFF to interrupt the starting cycle, the ignition system will also be shut off.

IGNITION CONTROLS.

Movement of the throttle outboard into the START detent actuates the ignition system limit switch, thus allowing current to be supplied to the ignition units. Ignition cut-off is accomplished automatically in 60 seconds by a time delay switch. The ignition circuit will not operate unless the engine start master toggle switch, located on the right console, is set forward to ON. While it is normally on at all times during flight, it should be noted that ignition for airstarts cannot be obtained with the engine start master switch at OFF.

**ENGINE STARTING SYSTEM.**

The starting system is designed to rotate the compressor and turbine wheels at the speed required to obtain a successful engine light-up when fuel and ignition are introduced in the combustion chambers.

**Note**

An external d-c power supply must be used for ground starts. The starter is not used for airstarts, as airspeed may be controlled by the pilot to maintain the proper engine windmilling speed for an engine light-up.

**ENGINE STARTING CONTROLS.**

ENGINE START MASTER SWITCH.

This two position, guarded toggle switch (40, figure 1-5), marked ON and OFF, is located on the right console. It operates in conjunction with the engine cranking switch and the limit switch at the START position on the throttle to control the starter and ignition circuits, respectively. The engine start master switch must be set to ON before the starter and ignition circuits can be energized by their respective control switches. Setting the switch to OFF removes power from the starter and ignition circuits when completion of a starting cycle is not desired (false start).

**Note**

For airstarts, the engine start master switch must be set to ON to enable the ignition system to be energized when the throttle is moved to START.

ENGINE CRANKING SWITCH.

This momentary switch (38, figure 1-5), equipped with a guard, is on the right console. With the engine start master switch ON, the engine cranking switch is held forward to START for two to three seconds to energize the starter for ground starts or for clear engine when the engine has failed to start and unburned fuel must be cleared. In this latter operation, the throttle is set at CLOSED. The engine cranking switch circuit is broken when the engine start master switch is OFF.

**AIRSTART EMERGENCY IGNITER SYSTEM CONTROL.**

The engine is equipped with an airstart emergency igniter system, which consists of a "T" handle control in the cabin connected by cables to the firing pins for two cartridges installed in combustion chambers No. 4

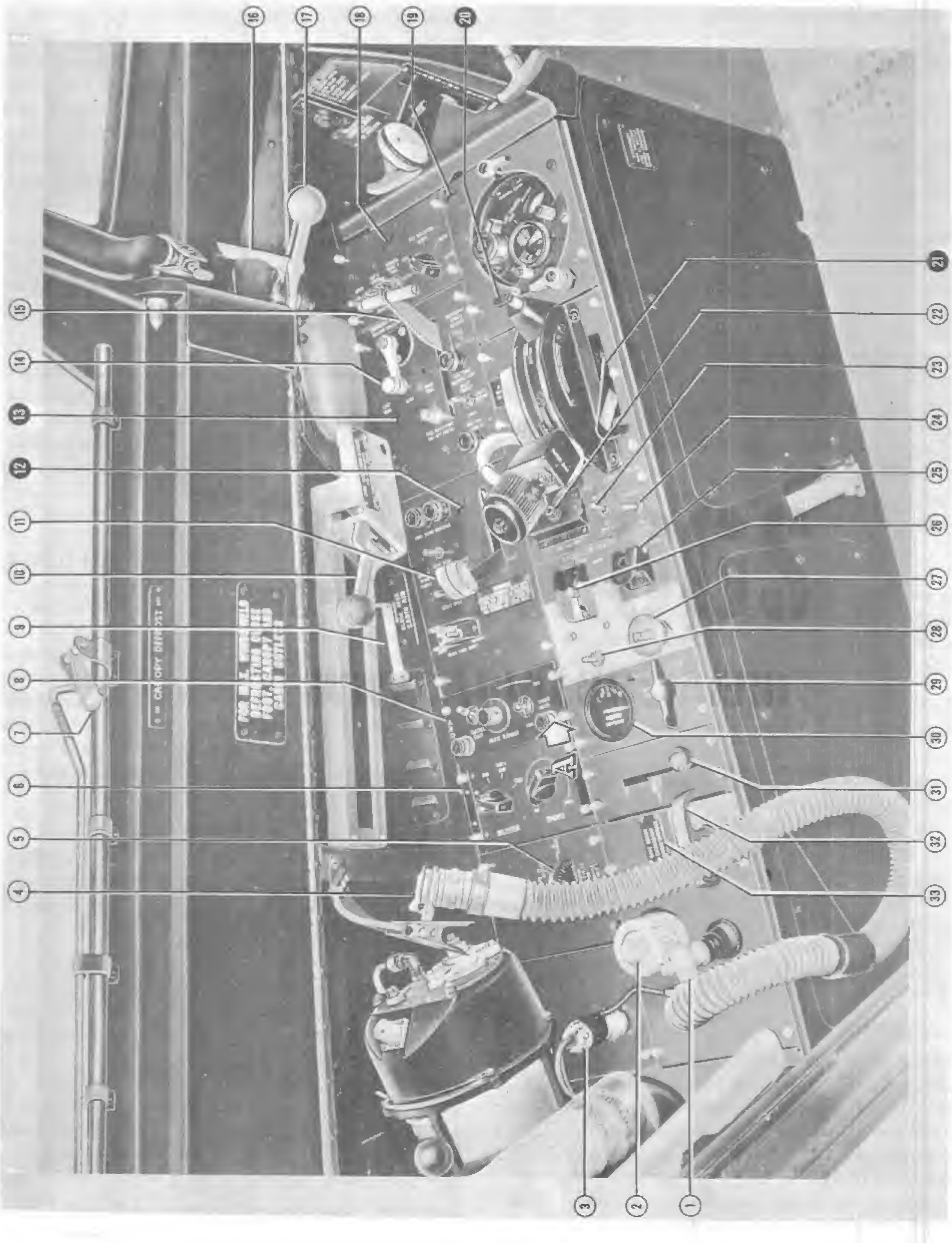
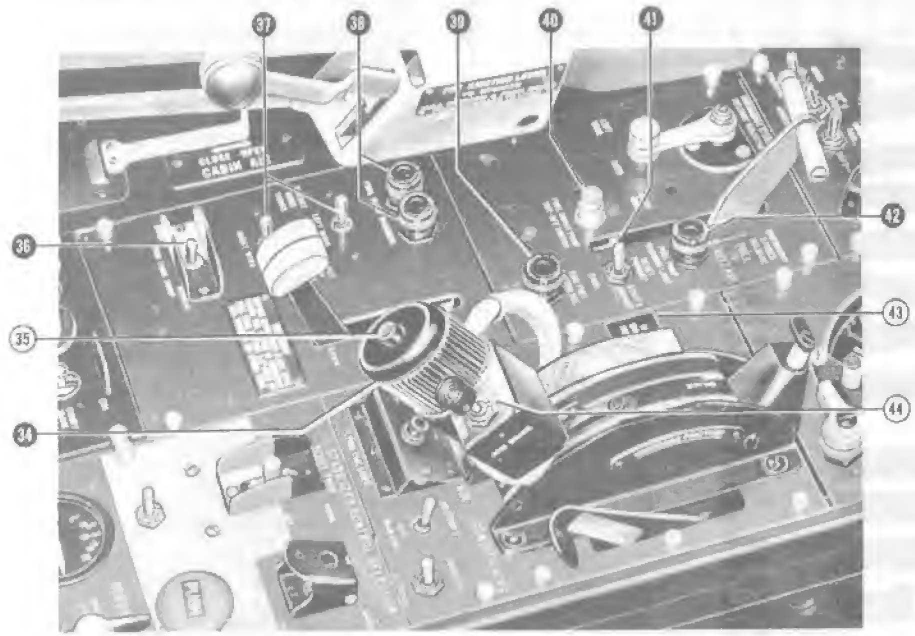


Figure 1-3. Cabin Interior—Left Side (Sheet 1 of 2)




DETAIL A

1. "G" Suit Tube Receptacle (Personal Gear Composite Disconnect to Suit)
2. "G" Suit Pressure Control Valve
3. Microphone and Headset Plug (Personal Gear Composite Disconnect to Microphone and Headset)
4. Oxygen Tube (Personal Gear Composite Disconnect to Mask)
5. Emergency Flaperette Air Pressure Gage
6. Mk 20 Mod O ACS Control Panel
7. Canopy Defroster Control Lever
8. Gun Ranging Radar Control Panel
9. Console Air Conditioning Outlet Control Handle
10. Ejection Seat Pre-ejection Lever
11. Wing Flaps Control Lever
12. Airplane Fuel System Control Panel
13. Engine Fuel System Control Panel
14. Stores Emergency Release Selector Lever
15. Stores Emergency Release "T" Handle
16. Canopy Emergency Control Lever
17. Canopy Normal Control Lever
18. Armament Control Panel
19. Oxygen Regulator and Control Panel
20. Catapult Grip
21. Throttle Friction Control Lever
22. Flying Tail Shift Circuit Breaker
23. Air Conditioning On-Off Switch
24. Air Conditioning Increase - Decrease Switch
25. Longitudinal Control System Selector Switch
26. Stabilizer Electrical Trim Selector Switch
27. Longitudinal Control System Emergency Manual Control Knob
28. Stabilizer Emergency Trim Switch
29. Rudder Trim Switch
30. Rudder Trim Position Indicator
31. Emergency Flaperette Power Control Lever
32. Wheel Brakes Emergency Control Handle
33. Location of Speed Brakes Emergency Landing Override Switch
34. Throttle Lever and Aero 4C Radar Ranging Control (Throttle Grip)
35. Microphone Switch
36. Wing Tank Dump Switch
37. Wing Tanks Selector Switches L/R
38. Fuel Flow Warning Lights
39. Engine Emergency Fuel System Indicator Light
40. Fuel Boost Pump Cut-off Switch
41. Engine Fuel System Selector Switch
42. Engine Fuel Pumps Warning Light
43. Location of Speed Brakes Circuit Breaker
44. Speed Brakes Switch

*Figure 1-3. Cabin Interior—Left Side (Sheet 2 of 2)*

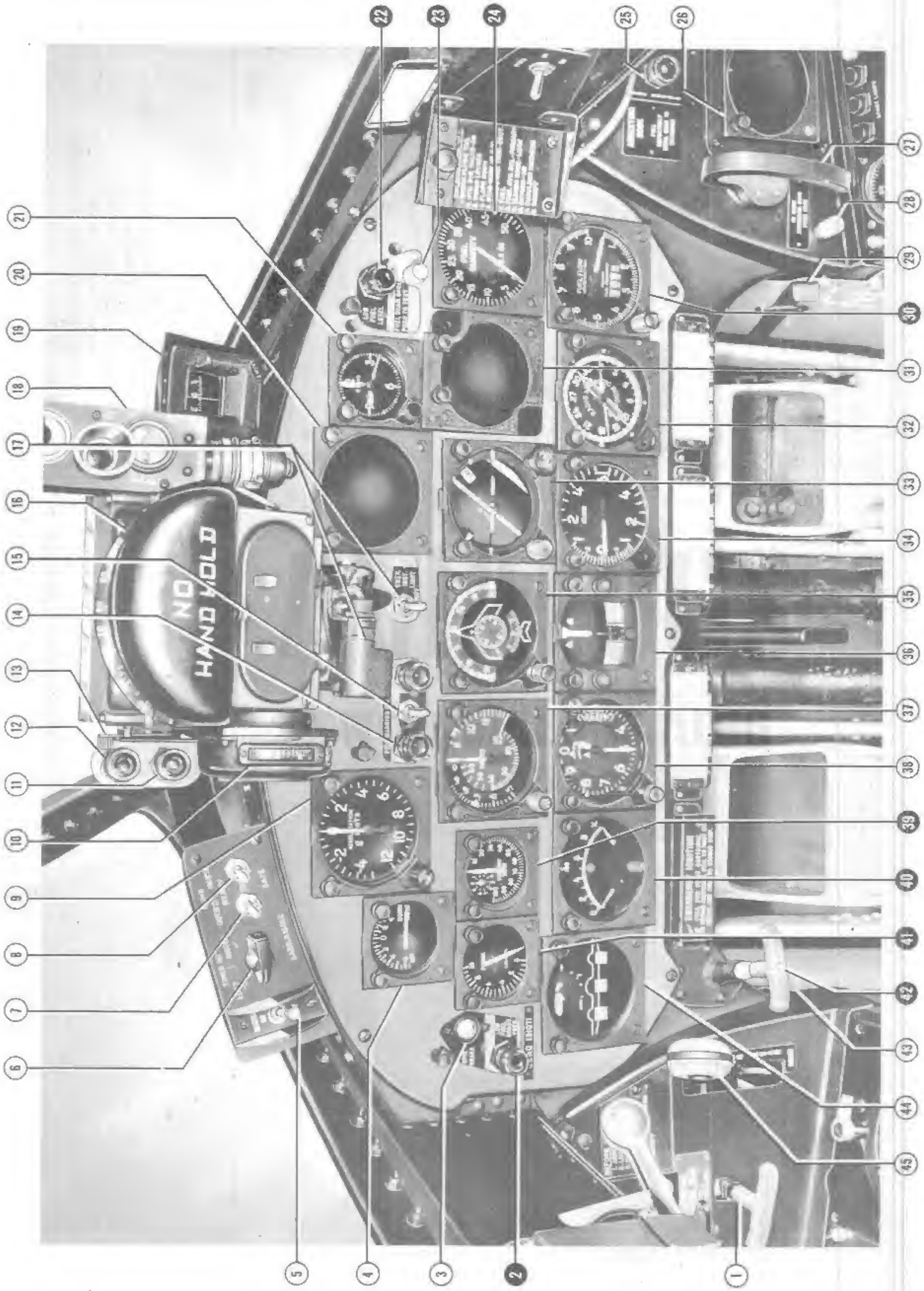



Figure 1-4. Cabin Interior—Forward

KEY TO FIGURE 1-4.

1. Landing Gear Emergency (Air) Control Handle
2. Low Fuel Boost Pressure Warning Light
3. Speed Brakes Position Indicator
4. Absolute Stabilizer Position Indicator
5. Armament Master Switch
6. LABS Angle Switch
7. Outboard Gun Charging Switch
8. Inboard Gun Charging Switch
9. Accelerometer
10. Range Scale
11. T-O Indicator Light
12. LABS Indicator Light
13. Fixed Reticle Masking Lever
14. Fire Warning Lights
15. Fire Warning Light Circuit Test Switch
16. Sight Unit and Target Span Scale
17. Emergency Instrument Light and Switch
18. Tracking Indicator
19. Stand-by Compass
20. Space provision for Dive and Roll Indicator
21. Clock
22. Low Fuel Level Warning Light
23. Fuel Quantity Gage Push-to-Test Switch
24. Fuel Quantity Indicator
25. Arresting Hook Position Warning Light
26. Space provision for Range Indicator
27. Arresting Hook and Barrier Guard Control Handle
28. Arresting Hook Raising Push Button Switch
29. Air Conditioning Foot Outlet Control
30. Fuel Flowmeter
31. Space provision for Course Indicator
32. Course Indicator
33. Gyro Horizon Indicator
34. Rate of Climb Indicator
35. G-2 Remote Compass Indicator
36. Turn and Bank Indicator
37. Airspeed and Mach Number Indicator
38. Altimeter
39. Tachometer Indicator
40. Tailpipe Temperature Indicator
41. Oil Pressure Indicator
42. Airstart Emergency Igniter Control
43. Landing Gear Control, Down Lock Solenoid Manual Release Knob
44. Wheels and Flaps Position Indicator
45. Landing Gear Normal Control Lever and Landing Gear Unlocked Warning Light

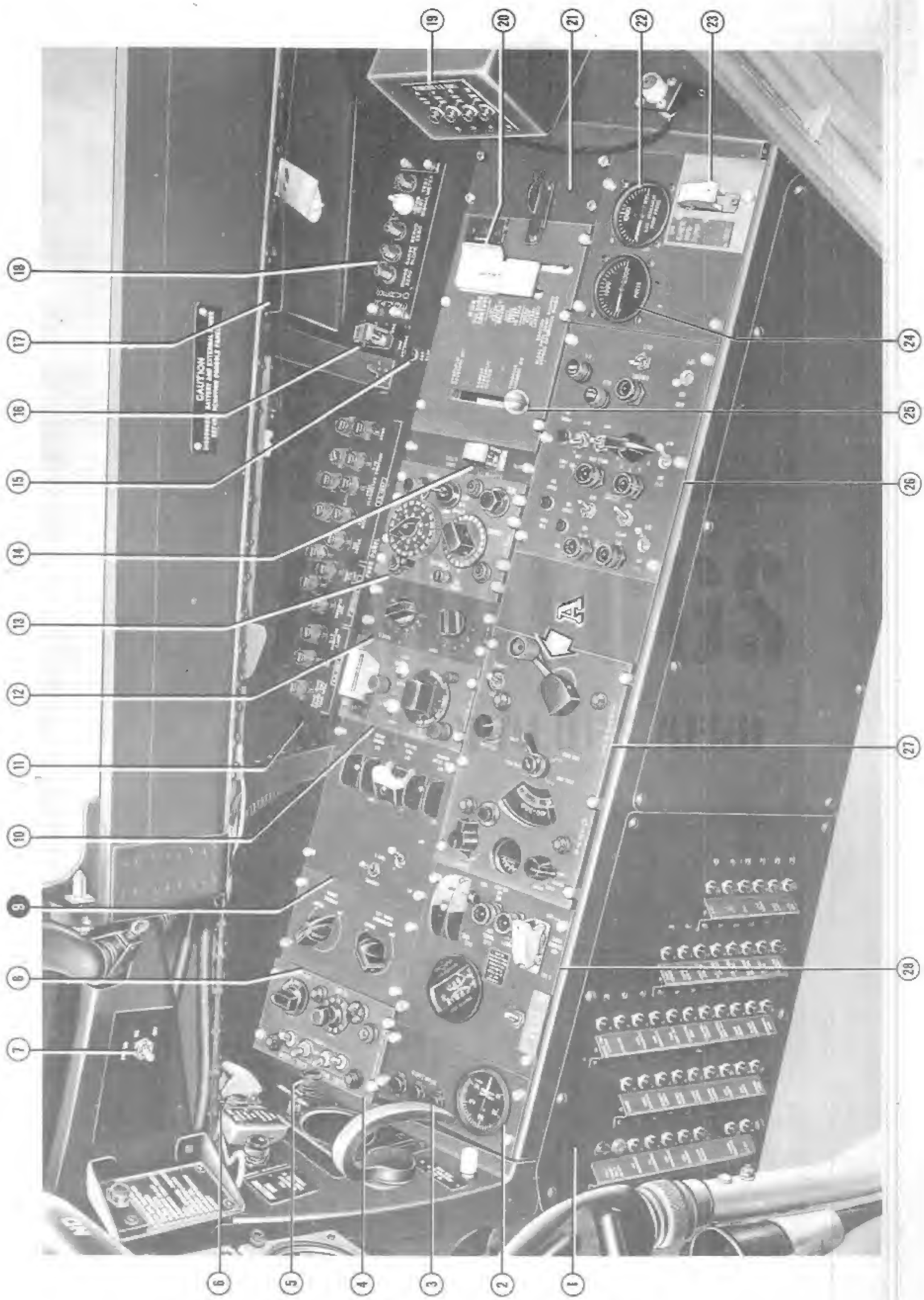
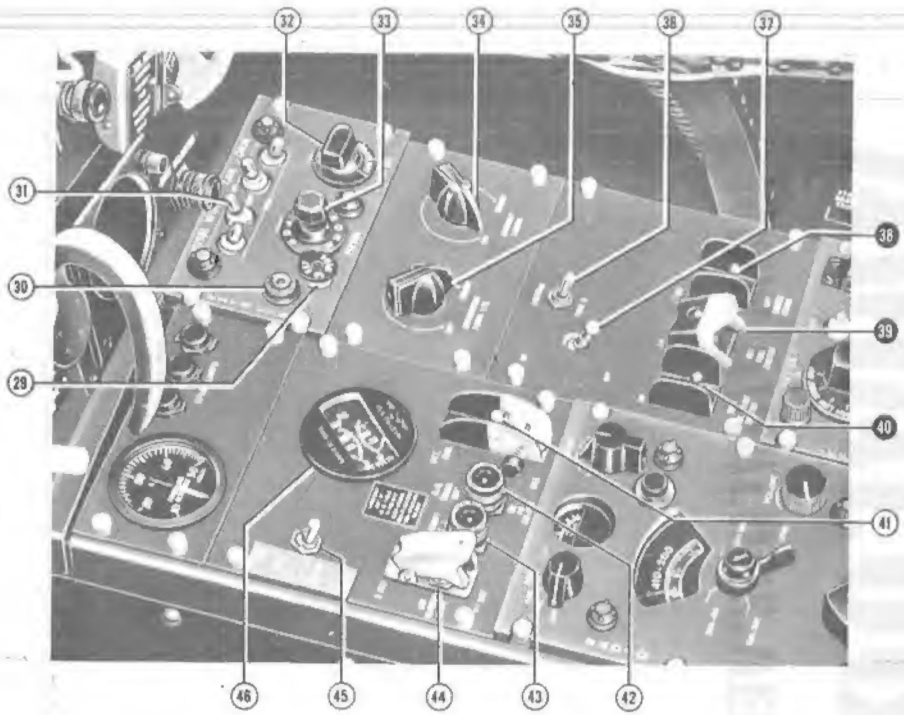



Figure 1-5. Cabin Interior—Right Side (Sheet 1 of 2)

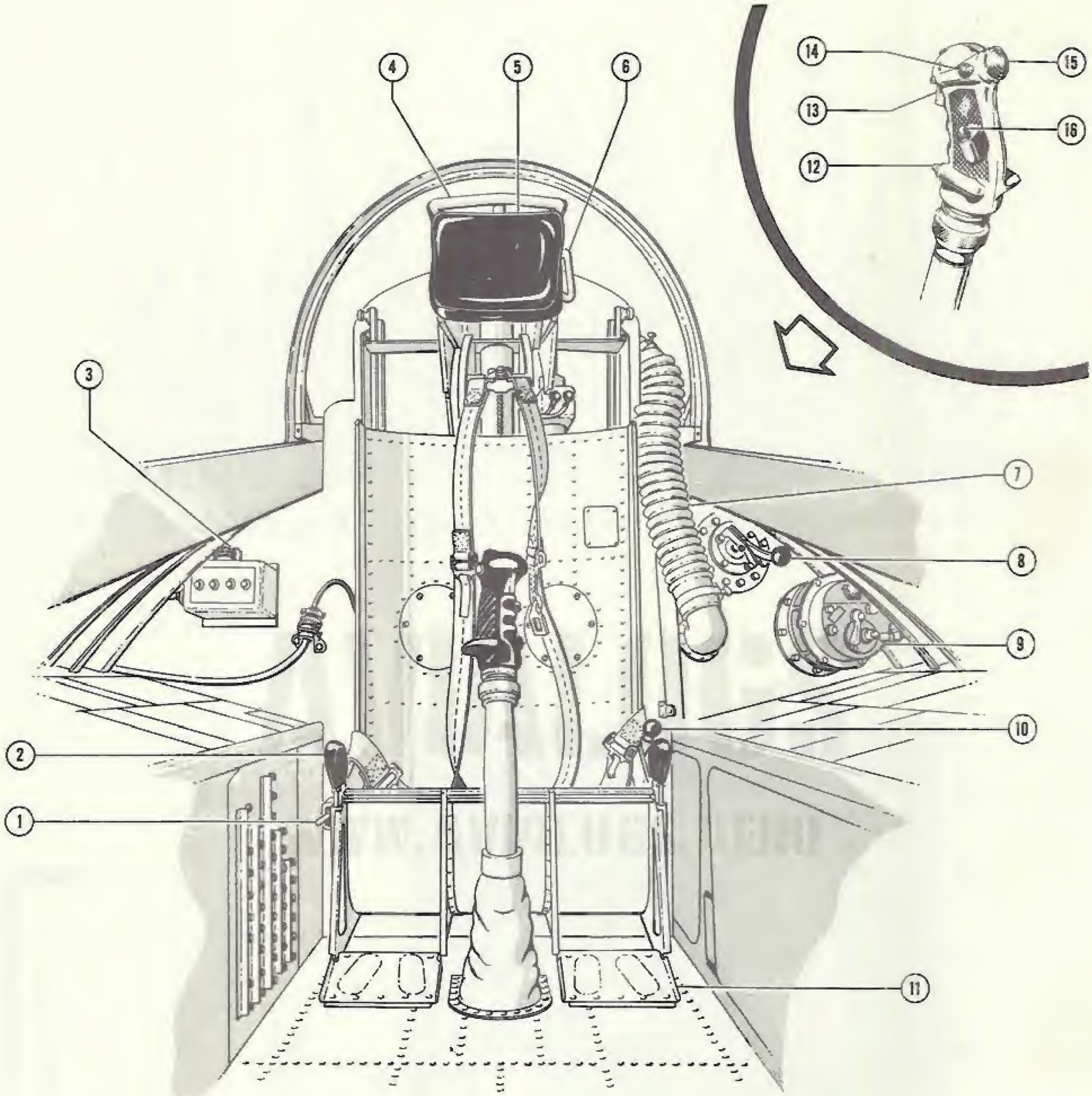



1. Circuit Breaker Panel
2. Cabin Pressure Altimeter
3. Spare Lamps
4. Exterior Lights Control Panel
5. Sliding Nose Unlocked Warning Light
6. Tail Skid Control Switch
7. Yaw Damper Power On-Off Switch
8. Interior Lights Control Panel
9. Engine and Miscellaneous Control Switch Panel
10. IFF Control Panel
11. Fuse Panel
12. IFF Coder Control Panel
13. UHF Command Set Control Panel
14. Flaperette Control Switch
15. Antenna Relay Switch Circuit Breaker[1]
16. Antenna Relay Control Switch[1]
17. Map Case
18. Unit II, Servo Radar Range Aero I
19. Stabilizer Control Power Circuit Breaker Panel
20. Wing Folding and Locking Control Levers
21. Spare Lamp and Fuse Container
22. Auxiliary Hydraulic System Pressure Gage
23. Auxiliary Hydraulic Pump Control Switch
24. Main Hydraulic System Pressure Gage
25. Combat Hydraulic System On-Off Control Lever
26. Special Weapons (LABS) Control Panel
27. Radio Compass Control Panel
28. Electrical Power Control Panel
29. Exterior Lights Manual Code Key
30. Code Key Indicator Light
31. Exterior Lights Control Switches (4)
32. Exterior Lights Master Switch
33. Code Selector Switch
34. Console Light Switch and Rheostat
35. Instrument Panel Light Switch and Rheostat
36. G-2 Compass Control Switch
37. Pitot Heat Control Switch
38. Engine Crank Switch
39. Fuel Master Switch
40. Engine Start Master Switch
41. Battery Switch
42. Generator Warning Light
43. Inverter Warning Light
44. Inverter Changeover Switch
45. Exterior Lights Auxiliary Master Switch
46. Voltammeter

**Note**

[1]Airplanes ser No. 131063 through 131070

*Figure 1-5. Cabin Interior—Right Side (Sheet 2 of 2)*




1. Electric Seat Height Control
2. Ejection Seat Knee Brace (2)
3. Utility Electrical Receptacle
4. Ejection Seat Face Cover Handle
5. Headrest
6. Emergency Ejection Seat Arming Control Handle
7. Canopy Defrosting Tube
8. Cabin Pressure Dump Valve Control Lever
9. Cabin Pressure Regulator
10. Shoulder Harness Inertia Reel Lock Control Lever
11. Ejection Seat Foot Rest (2)
12. Auto Pilot Emergency Off Switch (Not used)
13. Gun Trigger Switch
14. Bomb Release Switch (Not used)
15. Horizontal Stabilizer Trim and Wing Trim Control Button
16. Rocket Switch (Not used)

*Figure 1-6. Cabin Interior—Aft*

and 7. The "T" handle control (42, figure 1-4) is mounted on the bottom left side of the instrument panel. Pulling the handle aft to its first stop fires a single cartridge to provide emergency ignition for an airstart attempt. After firing the first cartridge, the second may be fired by pulling the handle aft to its first stop, rotating it 90 degrees in either direction and then pulling full aft.

**Note**

This control is spring loaded to return to its normal position after firing the first cartridge. To fire the second cartridge for a second airstart attempt, the handle must be pulled to the first stop, rotated 90 degrees in either direction, and then pulled out to its second stop. If the control is pulled through in a continuous motion, as described above, both cartridges will be fired in quick succession.

The emergency igniter system is provided as an additional safety device for use in case of failure to relight with the normal airstarting ignition system. It is important to note that only two ignition attempts are available with this emergency igniter system. The airstart emergency igniter system control is rigged so that the cartridges may be fired singly or in rapid succession, if desired. Therefore, these emergency igniters should be used only when attempts to ignite with the normal airstarting igniter system have failed, or when time permits, only one, or at the most, two possible relighting attempts. Conditions should be set as nearly as possible to those outlined in Section III before attempting starts with emergency igniters. All starting attempts should be made with a single igniter except under extreme circumstances when time will permit only one attempt. In this case, both igniters should be fired in rapid succession.

### ENGINE INDICATORS.

#### TACHOMETER INDICATOR.

The tachometer (39, figure 1-4) is on the main instrument panel to the left of the center line. It indicates engine rpm in percentage of military rpm (100% = 11000). The dial is numbered in tens from 0 to 100. A small pointer rotating over a sub-dial which shows graduations of one per cent of engine rpm provides more accurate reading than the large pointer.

#### TAILPIPE TEMPERATURE INDICATOR.

This indicator (40, figure 1-4), on the main instrument panel to the left of the center line, shows tailpipe temperature in degrees centigrade times 100. It is numbered from 0 to 10 in increments of two. There are two pointers on the dial face of the instrument. The left one is the indicating pointer and the right the reference pointer. The latter pointer may be set to any position by turning the screw at the bottom of the dial face. The clockwise movement of the indicating pointer is stopped by the reference pointer. When the indicating pointer contacts the reference pointer, a warning light incorporated in the indicator dial face will glow.

**Note**

The reference pointer should always be set at the highest tailpipe temperature limit (800°C) as the indicating pointer cannot indicate readings above the setting of the reference pointer.

### FIRE WARNING INDICATOR LIGHTS.

Two red press-to-test fire warning lights (14, 15, figure 1-4) with a warning light circuit test toggle switch, are located on the top of the instrument panel to the left of the center line. The lights are energized by fire warning detectors located at various points around the engine to warn of engine compartment fire. The left light is energized by the forward bank of fire detectors and the right one by the aft bank of fire detectors. The lights will glow when the fire warning test switch is actuated, indicating that the fire warning light circuit is in working order.

### OIL SYSTEM.

The engine oil system is a self-contained high pressure system which provides pressure oil feed to the three main bearings and the accessory drives. The bulk of the oil is contained in an oil tank located on the inner side of the front air inlet screen support. The oil sump contains a three-section, engine driven oil pump, four oil strainers and provisions for the oil pressure gage connections. The middle section of the pump draws oil from the tank and forces it through tubing to nozzles which lubricate the accessory case drives and the front, center, and rear bearings. Engine drain oil from the center and rear bearings is scavenged by the upper section; and from the front bearing, accessory drives and pressure oil relief valve, by the lower section. The oil from both pump sections is combined and returned to the tank through a single line. The oil reservoir is filled through a fillerneck on the fuselage right side, accessible through a fillercap below the auxiliary air door. The oil system capacity is 26 US pints with a foaming space of approximately 20 US pints. See figure 1-2 for oil grade and specification.

**WARNING**

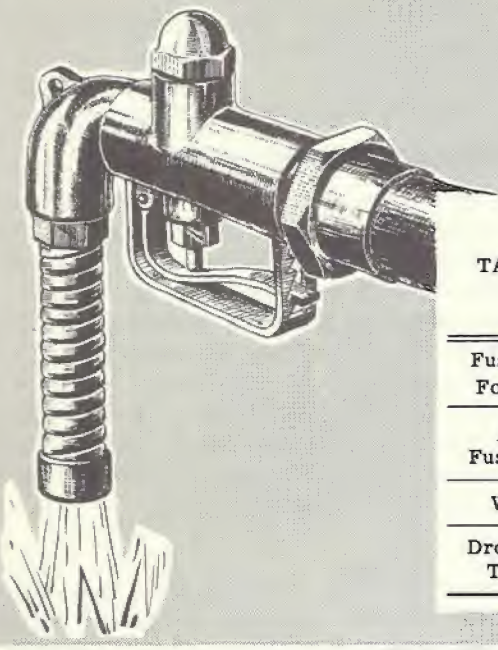
Inverted flight is limited to 10 seconds by the engine oil system.

#### OIL PRESSURE INDICATOR.

The oil pressure indicator (41, figure 1-4) is on the left side of the main instrument panel. Its range is from 0 to 100 psi. The desired oil pressure operating range is from 10 psi minimum to 45 psi maximum.

## AIRPLANE FUEL SYSTEM.

The forward (main) tank and the rear tanks are of the soft, self-sealing type and are located between the



## FUEL QUANTITY DATA
### U.S. GALLONS

| TANKS | NO. | USABLE FUEL LEVEL FLIGHT (each) | UNUSABLE FUEL LEVEL FLIGHT (each) | EXPANSION SPACE (each) | TOTAL VOLUME (each) |
|---|---|---|---|---|---|
| Fuselage Foward | 1 | 587 | 27 | 19 | 633 |
| Aft Fuselage | 1 | 236 | 0 | 7 | 243 |
| Wing | 2 | 108.5 | 0.5 | 4 | 113 |
| Droppable Tanks | 2 | | | | |

*Figure 1-7. Fuel Quantity Data Table*

## MAXIMUM ATTAINABLE % RPM vs FUEL QUANTITY
F9F-8 AIRPLANE J48-P-8 ENGINE SEA LEVEL

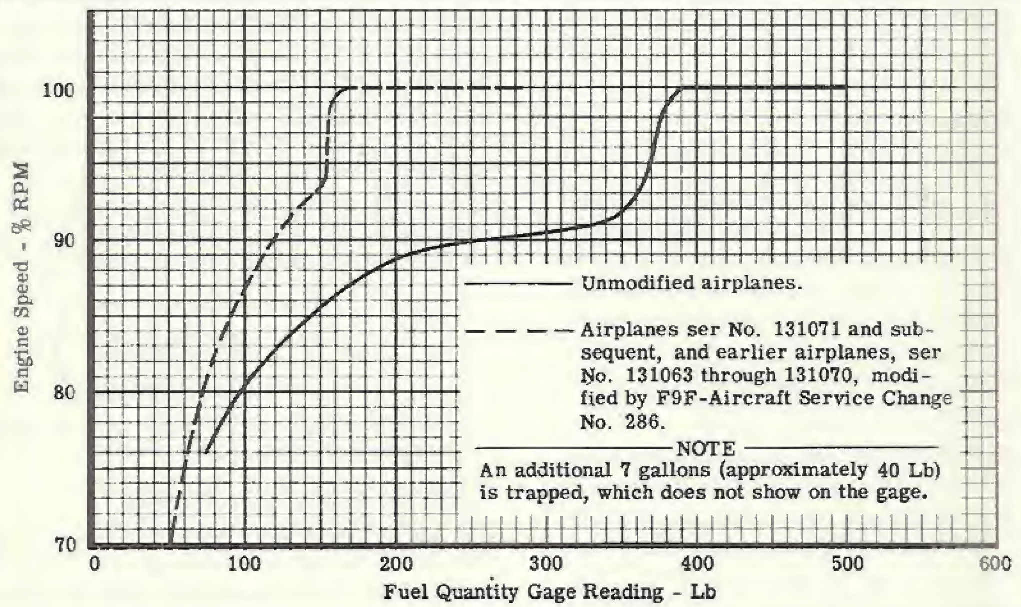



*Figure 1-8. Maximum Attainable Percent RPM vs Fuel Quantity Curves*

cabin and the engine. Two interconnected non-sealing bladder type tanks run the span of the wing outer panel between the front and main beams. The cambered leading edge of each wing is an integral tank interconnected to the wing tanks. A 150 gallon drop tank may be supported by each bomb rack. An electrical system is provided for dumping the fuel from the wing tanks in an emergency. See figure 1-2 for fuel grade and specification and figure 1-7 for fuel quantity data. The fuselage tanks are pressurized by ram air let into the tanks from a scoop on the fuselage bottom. The wing tanks are pressurized from ram air inlets at the wing tip leading edges, which are equipped with spring loaded valves. For dumping fuel, these inlet valves are opened to permit full ram air pressure to enter the tanks, and the dump valves are opened to permit fuel to jettison through the dump nozzles.

This is a constant feed system, i.e., fuel flows from the wing and/or drop tanks and rear fuselage tank to the forward fuselage tank. A check valve in the line connecting the fuselage tanks prevents reverse flow from the forward to the rear tank. A check valve in each drop tank line prevents fuel flow from the respective wing tank into the drop tank. The fuel level in the fuselage tanks is approximately the same until the rear tank is emptied, at which time approximately 100 gallons remain in the forward tank. All fuel feed to the engine is from the forward tank.

There are certain limitations to flying with low fuel quantities. Figure 1-8 shows the maximum attainable engine speed vs indicated fuel quantity. 100% rpm cannot be maintained with less than 400 pounds of fuel. (The engine ~~fuel pumps warning~~ light will be on.) Approximately 83% rpm is required for carrier approach and therefore, the unusable fuel quantity of figure 1-7 is 27 gallons, composed of seven gallons trapped and 20 gallons unusable in flight. Since loss of thrust is gradual (as fuel is used), some warning is provided. See Low Fuel Quantity paragraph, Section III.

The dashed line curve of figure 1-8 applies to later airplanes.[1] Earlier airplanes may be modified to this configuration by F9F Aircraft Service Change No. 286. The fuel quantities discussed above and shown in figure 1-7 represent fuel quantity gage readings in level flight, including level coordinated turns. Higher rpm for the same fuel quantity will be obtained for the engine on a warm day or at higher altitude because of the lower fuel flow required corresponding to the lower thrust.

NORMAL OPERATION.

When the fuel system master switch is ON, the shut-off valve is opened and the tank boost pump sends fuel to the engine at 6 to 25 psi. When a wing or drop tank is selected, a selector valve in the selected wing is correspondingly positioned and a transfer pump sends fuel from that wing tank into the forward fuselage tank, provided the circuit to the transfer pump has been armed by action of the float switch in the forward tank when space is available in that tank. A red warning light glows when the selected tank in either wing has been emptied, provided that fuel level in the forward tank is below full and the transfer pump is operating. A fuel flow indicator switch, located upstream of the transfer pump in each wing fuel line, will illuminate the warning light when fuel flow through that line drops to less than 1.0 gpm. If the forward tank is full, its float switch will not permit the transfer pump to operate and the lights will not glow, having been deenergized temporarily by pump stoppage. In addition, a fuel level control valve in the forward tank will prevent overfilling in the event of float switch failure. A seven gallon reservoir in the bottom of the forward tank maintains constant feed for inverted flight or maneuvers for approximately 10 seconds when 90 gallons of fuel remain in the tank. With less than 90 gallons, there will be proportionately less fuel in the reservoir. Fuel quantity in the fuselage tanks is measured by capacitance units. A fuel flowmeter shows rate of flow and amount of fuel remaining (both in pounds) in the system.

**FUEL SYSTEM CONTROLS.**

WING TANK SELECTOR SWITCHES.

Two switches (37, figure 1-3), on the fuel control panel of the left console, control the transfer pump. The forward switch is for the left wing tank, the aft for the right tank. Moving either switch to the SELECT WING TANKS position turns on the electric transfer pump which sends fuel from the selected wing tank to the forward fuselage tank. Moving either switch to the SELECT DROP TANKS position turns on the pump which sends fuel from the selected drop tank to the forward fuselage tank. If the forward tank is full, a float switch will prevent the transfer pump for operating. Setting either switch to the center (off) position stops transfer of fuel from the selected tank by shutting off the associated selector valve and the transfer pump. When a tank shows empty, its selector switch should be set to center (off). Both switches must be set to center (off) to stop the electric transfer pump.

The selector switches are identified left wing and right wing, and each has three positions: SELECT WING TANKS, SELECT DROP TANKS, and a center (off) position. Moving either switch out of the off position sets a wing tank selector valve to the selected wing or drop tank position, opening the line for fuel flow, and turns on the transfer pump. Final stages of transfer will result in a passage of air and fuel which will cause intermittent operation of the fuel flow switch and a corresponding flickering in the warning light. This is a normal condition. When either light glows steadily, the associated switch should be set to off. The other switch should be left in the selected position until the light glows steadily again. Failure to set either switch to off when its light glows may result in leaving some fuel in one tank, as the transfer pump will suck air from the empty tank. This will decrease the flow from the

[1] F9F-8 airplanes ser No. 131071 and subsequent.

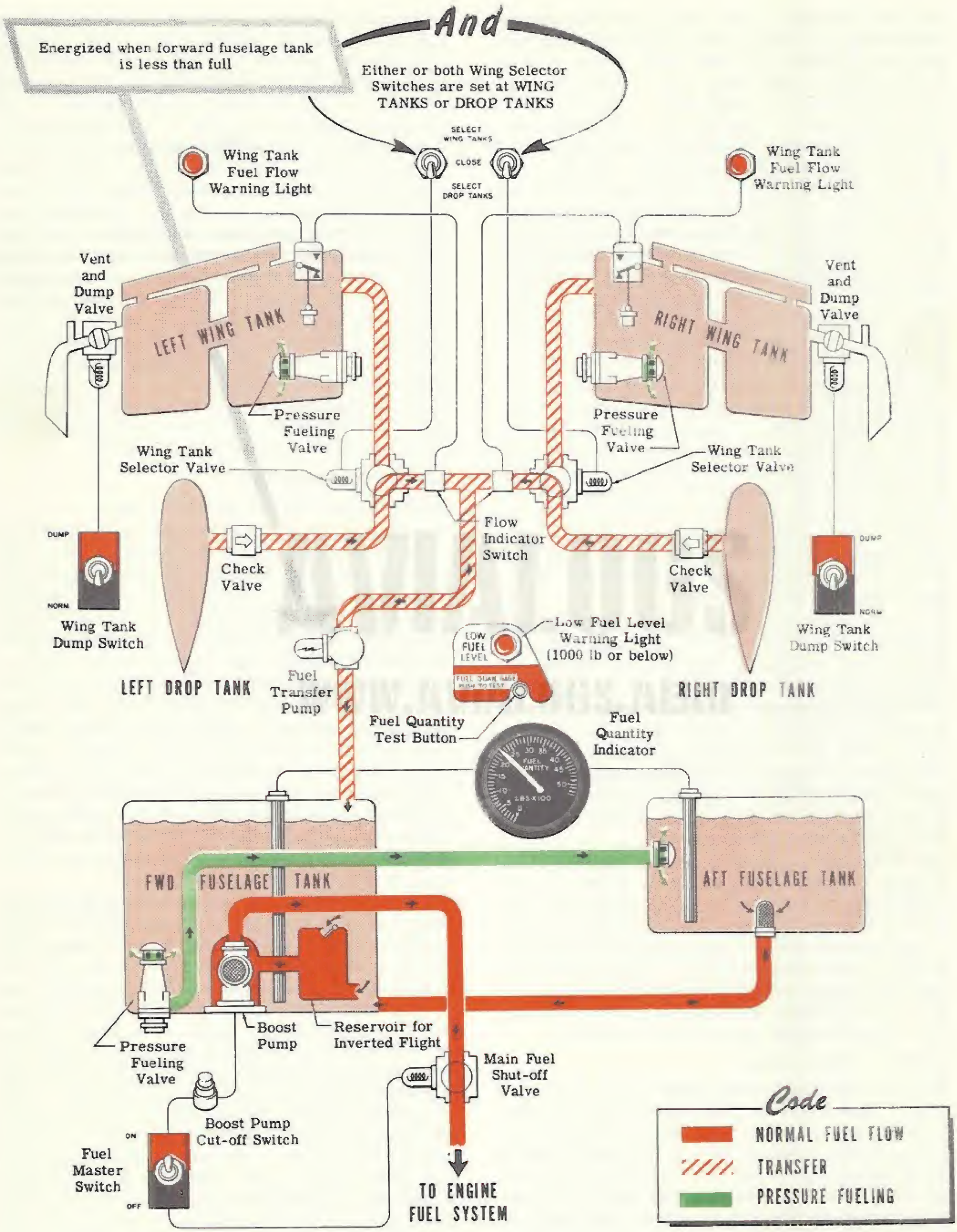



*Figure 1-9. Fuel System Schematic Diagram*

tank containing fuel, possibly below the flow indicator switch setting of 1.0 gpm, and result in a false indication of empty.

WING TANK DUMP SWITCH.

This two position switch (36, figure 1-3) is mounted in a channel type guard on the fuel control panel of the left console. Movement of the switch outboard to DUMP actuates an electric motor which opens the dump valves in both wing tanks and allows ram air to force the fuel out the nozzle into the airstream. This switch is left at the NORMAL position for normal operation until it is desired to dump wing tank fuel or to purge the tanks after wing tank fuel has been exhausted. In either case, after the switch has been set to DUMP, it must be left there to ensure complete purging. Reset to NORMAL before landing.

### FUEL SYSTEM INDICATORS.

Also see Engine Fuel Control System.

FUEL QUANTITY INDICATOR.

The fuel quantity indicator (24, figure 1-4), on the right side of the main instrument panel, shows quantity of fuel in pounds. The dial is marked 0-55 and indicates pounds times 100. The indicator is operated by electric capacitance units in the front and rear tanks (there is no quantity indication for the wing tanks). A push button (23, figure 1-4) is installed above the indicator to check operation of the system. With the battery switch set to BAT. & GEN., pushing this button will cause the indicator pointer to move to the low end of the dial. If the system is operating properly, the pointer will return to its original indication when the button is released.

**Note**

Fuel varies in weight per gallon, dependent upon its specific gravity and temperature. Therefore, the notation FULL does not appear on the indicator dial and the pilot should anticipate variations in the instrument readings when the fuel tanks are full.

No calibration placard is required in this airplane, as the gage calibration at cruise does not differ from that in the three point position.

LOW FUEL LEVEL WARNING LIGHT.

This red light (22, figure 1-4), on the right side of the main instrument panel above the quantity indicator, glows when approximately 1250 pounds of fuel (30 minutes flight at maximum endurance cruise power setting at sea level or 20 minutes at maximum range) remain in the system.

**WARNING**

Descents with the low fuel level warning light on must be made in accordance with the procedure given in Appendix I, Description of Charts and Tables paragraph, step h.

FUEL FLOW WARNING LIGHTS.

Warning lights for each wing (38, figure 1-3) operated by float switches and the fuel flow indicator switches, glow when the tanks are empty. They are located on the fuel control panel on the left console forward of the wing tank selector switches. The lights will glow only when the fuel level in the forward tank is below full and the transfer pump is in operation.

FLOWMETER.

The fuel flowmeter (30, figure 1-4) is on the lower right corner of the main instrument panel. The indicator which shows the rate of flow (in pounds per hour) and a counter which shows the amount of fuel remaining (in pounds). The counter must be reset at each refueling to indicate total fuel aboard at the start of a flight.

### DROP TANK EMERGENCY JETTISON CONTROLS.

ELECTRICAL CONTROLS.

The drop tanks may be jettisoned by means of the rack selector switch, the armament master switch and the bomb release switch. The rack selector switch, on the armament control panel (18, figure 1-3), has three positions, LEFT, RIGHT or BOTH, by which the tank(s) to be jettisoned is selected. The armament master switch (5, figure 1-4), on the armament switch panel mounted on the windshield deck, is set to ON to energize the electrical circuit. The bomb release switch (14, figure 1-6) on the control stick grip is pressed to jettison the tank(s).

HYDRAULIC CONTROLS.

The drop tanks may be jettisoned by means of a selector and a "T" handle located on the fuel control panel on the left console.

**Note**

This control, together with the emergency stores release selector lever, may be used to jettison other stores carried on the same bomb racks.

STORES EMERGENCY RELEASE SELECTOR LEVER.

The stores emergency release selector lever (14, figure 1-3) has three positions: LEFT WING, BOTH, and RIGHT WING, by which the tank(s) to be jettisoned is selected.

STORES EMERGENCY RELEASE CONTROL.

The stores emergency release "T" handle (15, figure 1-3) is pulled aft to jettison the tanks selected. When this handle is pulled aft, a master hydraulic cylinder is operated which pressurizes either or both slave units (one on each bomb rack) to actuate the stores release mechanisms on the bomb racks.

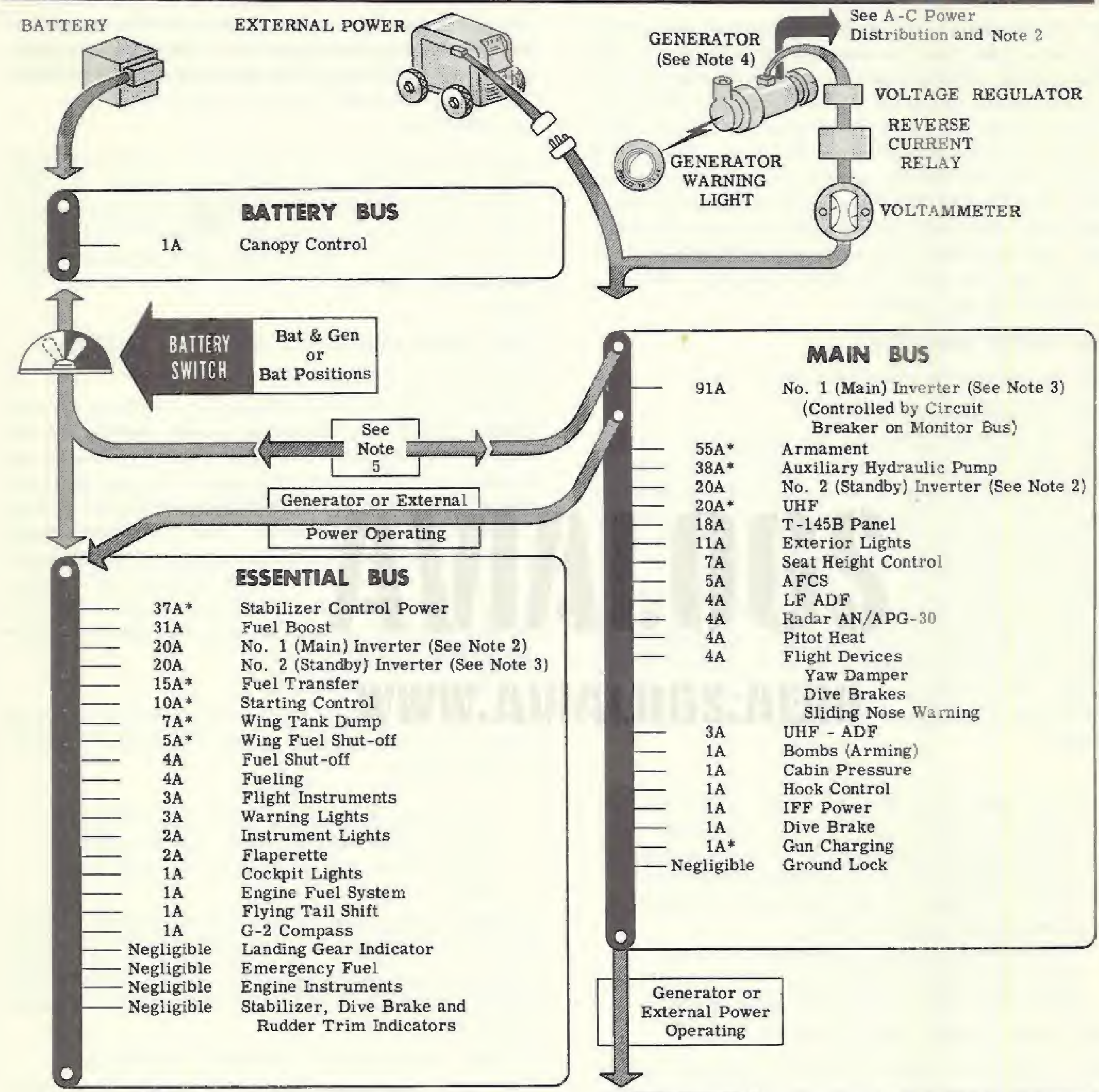
**Note**

This hydraulic system is independent of the main hydraulic system.

## ELECTRICAL SYSTEM.

The basic system is a 28 volt, direct-current, open wire system which uses the aircraft structure for a ground.

# D-C ELECTRICAL POWER DISTRIBUTION




*Note*

1. *Indicates Maximum Selective Loads (combined with Steady Condition Loads where such loads exist).
2. Airplanes Serial No. 131063 through 131070.
3. Airplanes Serial No. 131071 and subsequent.
4. With landing gear down, movement of the throttle to idle position cuts off the generator and lights the generator warning light when No. 2 A-C Inverter is operating (See A-C Power Distribution).
5. If the generator fails (and battery switch is in Bat & Gen position) the Main Bus is disconnected from the Battery Bus unless the landing gear is down.

*Figure 1-10. D-C Power System Schematic Diagram*

Power is provided by a combination a-c—d-c generator and a battery. These, plus an a-c voltage regulator, a d-c voltage regulator, a reverse-current relay, wiring and bus bars, make up the main supply circuit. The controls, with the exception of armament, engine and certain special items, are on the right console. See figures 1-10 and 1-11 for additional information on the electrical system.

### D-C POWER.

An engine driven combination a-c—d-c generator, rated at 200 amperes at a potential of 30 volts, is regulated to 27.7 + 0.2 −0.0 volts and forms the principal d-c power source. It provides the required electrical energy to operate the various units of electrical equipment and, in addition, maintains the battery in a charged condition. A 24 volt, 34 ampere-hour storage battery serves as a stand-by or emergency source of power. An external source of dc may be connected to the airplane for ground operation and test purposes. Power distribution is accomplished through a multiple bus network; i.e., battery, essential, main and monitor. The three position battery and generator switch controls system operation and provides manual override in emergencies to permit operation of certain equipment normally deenergized when generator failure occurs. The generator system is equipped with standard controls; i.e., generator control relay and voltage regulator. The battery relay, battery relay transfer switch, monitor bus relay "A", monitor bus relay "B", essential bus relay, ammeter shunt, voltammeter, generator warning light and system external power receptacle complete the d-c power supply system.

The battery, generator and the external power source are connected in parallel with the main bus. The battery is connected through the battery relay, the generator through the generator control relay and external power through the system external power receptacle. The main bus, threfore, serves as the main distribution point for d-c power. The battery relay may be energized directly from the storage battery or from the generator, depending upon system requirements.

Monitor bus relays "A" and "B" are energized from the IND terminal of the generator control relay when the generated potential is above battery potential, or from the system external power receptacle when an external source of electrical power is connected to the airplane. Monitor bus relay "A" transfers generator or external power from the main bus to the essential and monitor buses. Monitor bus relay "B" functions to control the battery relay through the battery relay transfer switch when the landing gear control lever is set to UP. In this condition, the battery relay is energized by the generator power received from the monitor bus. Since the main bus is connected to the battery bus through the battery relay contacts, the main bus and connecting circuits are automatically deenergized when generator operation is interrupted. Monitor bus relay "B" also serves to control the generator warning light circuit.

The essential bus relay transfers power from the battery bus to the essential bus. The essential bus relay is energized from either the battery bus or the main bus when the battery and generator switch is set to BAT. & GEN. position. The essential bus relay is energized by battery power on the battery bus, or by generator or external power on the main bus, providing this potential is greater than that of the battery.

### A-C POWER.

In addition to the a-c output of the engine driven generator, two inverters, known as No. 1 and No. 2 are provided to supply three phase, 115 volt, 400 cycle alternating current. Both inverters are powered by dc from the essential bus and each one is protected from overloads by a circuit breaker.

Both inverters operate continuously. Normally, the No. 1 inverter powers the G-2 compass, gyro horizon indicator, fuel flowmeter, fuel quantity indicator and, through the 26 volt transformer, the oil pressure indicator. The No. 2 inverter normally powers certain circuits of the AN/APG-30 system. A guarded inverter changeover selector switch and an inverter warning light are provided on the right console. The inverter changeover selector switch has two positions: #1 INV. and #2 INV. When this switch is set to #1 INV., equipment normally powered by the No. 1 and No. 2 inverters, as described above, is energized. In the event of No. 1 inverter failure while the inverter changeover selector switch is set at #1 INV., the inverter warning light will glow. Setting the inverter changeover selector switch to #2 INV. diverts the output of the No. 2 inverter to equipment normally powered by the No. 1 inverter. However, power is then no longer available to energize the AN/APG-30 circuits. In the event of No. 2 inverter failure while the inverter changeover selector switch is set at #2 INV., the inverter light will glow.

**Note**

> The inverter warning light will indicate only the failure of the No. 1 inverter when the inverter changeover selector switch is set at #1 INV. and the failure of the No. 2 inverter when the switch is set at #2 INV.

### EXTERNAL POWER RECEPTACLES.

#### D-C EXTERNAL POWER RECEPTACLES.

Two external d-c power receptacles are provided on the underside of the fuselage aft of the main wheels. One receptacle is for engine starting only, the other supplies power to the entire d-c system with the exception of the starter. When external d-c power is plugged in for the d-c system and the battery and generator switch is set at BAT. or BAT. & GEN., the battery, main, essential and monitor buses are automatically energized and all equipment normally powered by these buses may be operated. When external power is plugged in and battery and generator switch is set at OFF, the battery bus is disconnected from the circuits. This disconnection of the

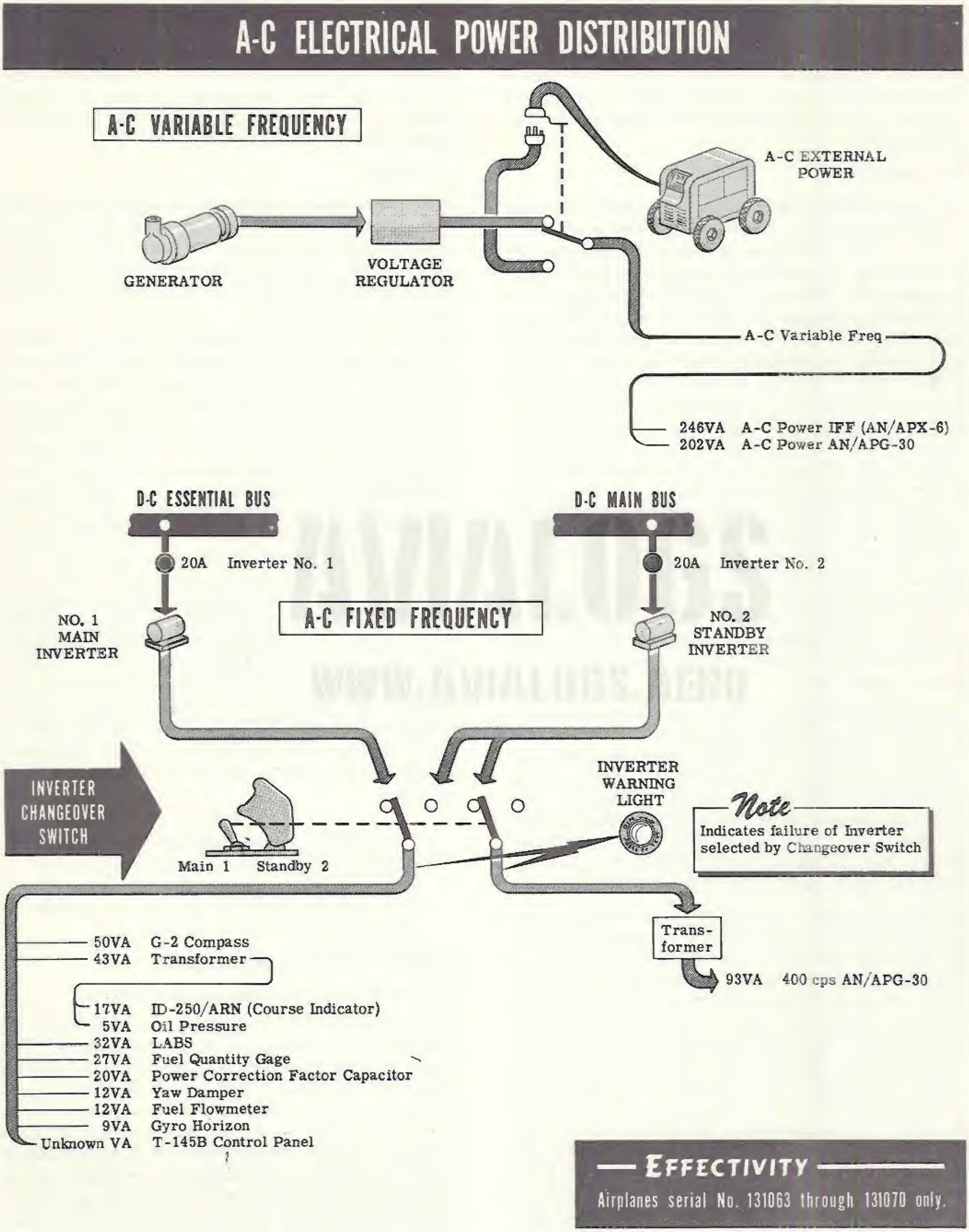
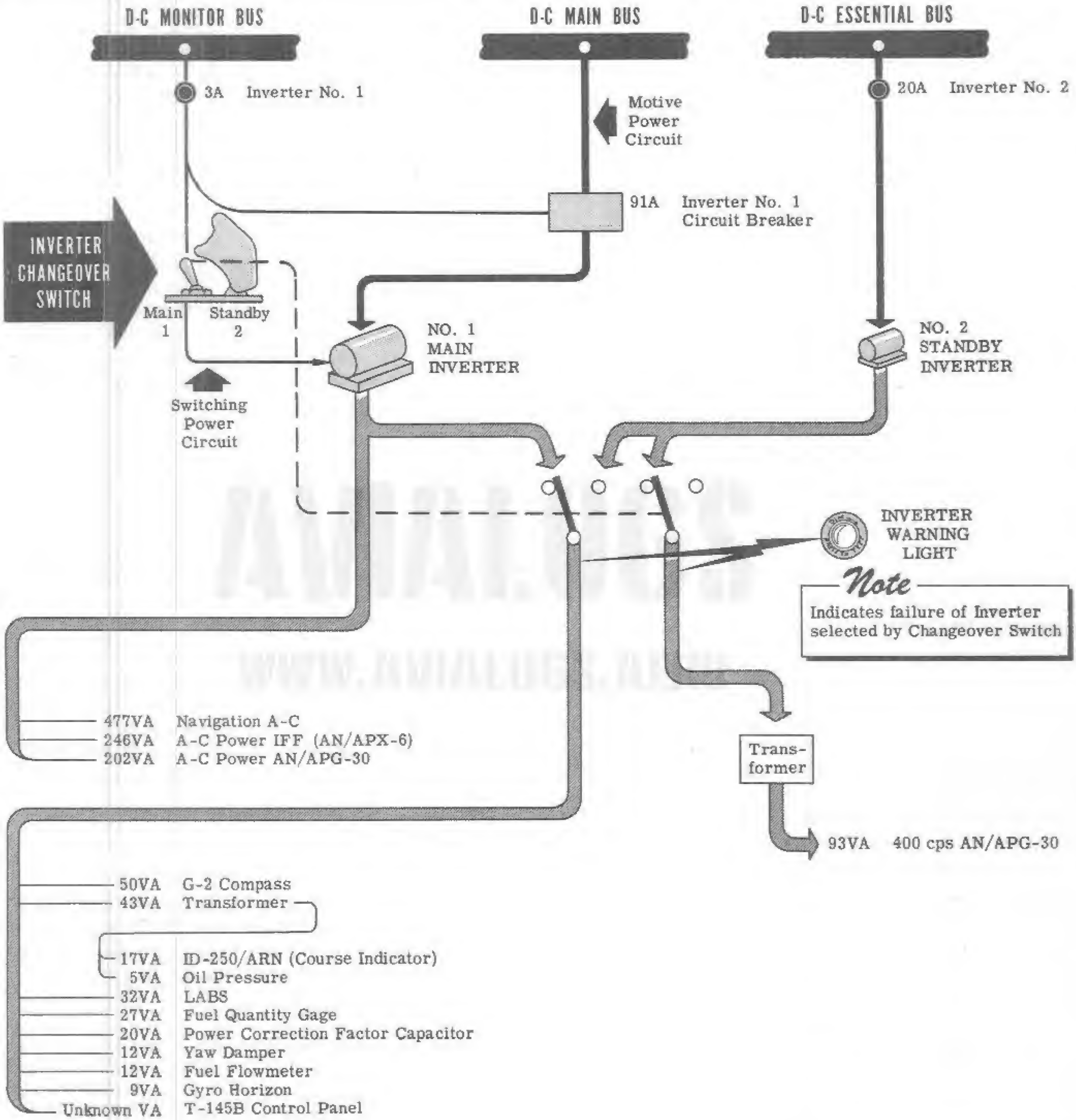



*Figure 1-11. A-C Power System Schematic Diagram (Sheet 1 of 2)*

# A-C ELECTRICAL POWER DISTRIBUTION




**— EFFECTIVITY —**
Airplanes serial No. 131071 and subsequent.

*Figure 1-11. A-C Power System Schematic Diagram (Sheet 2 of 2)*

battery bus eliminates the possibility of overcharging the battery as a result of having it connected to the external power source for an extended period of time.

A-C EXTERNAL POWER RECEPTACLE.

An external a-c power receptacle is provided in the nose wheel well for ground operation and testing of the AN/APG-30 gun ranging radar equipment and the AN/APX-6 IFF equipment.

**NORMAL CONTROLS.**

BATTERY SWITCH.

The single battery and generator toggle switch (41, figure 1-5) is on the electrical control panel, forward, on the right console. There are three switch settings: BAT. & GEN., OFF and BAT. The switch controls current to three bus bars, the main d-c bus, the essential bus and the monitor bus, which supply current to the various circuits in the airplane. With the landing gear control at DOWN (airplane in ground status), when the switch is set at BAT. & GEN., all three buses become energized and all electrical equipment may be operated (by operating the respective control switches), provided generator voltage is in excess of battery voltage or external power is connected. In flight status, should the generator fail, or if output is not in excess of battery voltage (indicated by warning light glow), the monitor and main d-c buses will be disconnected automatically and all circuits connected to these buses made inoperative. However, the essential bus will remain live and those circuits connected to it will be operative (warning lights, engine instruments, flight instruments, instrument lights, fuel selector, fuel system, tank dump, fuel shut-off, wing fuel transfer and fuel boost pumps). If the switch is set at BAT. in this situation, the main d-c bus will be energized again and the circuits connected to it will be operative, but the monitor bus will remain dead and its circuits (gun camera and utility receptacle) will remain inoperative. However, when the switch is set to BAT., it is MANDATORY THAT CIRCUITS NOT NECESSARY BE DISCONNECTED by setting applicable switches to OFF, since BATTERY POWER IS ADEQUATE FOR ONLY A SHORT TIME. The essential bus supplies all circuits necessary to flight and is energized in both BAT. & GEN. and BAT. switch positions. Setting the switch to OFF cuts off all equipment except the canopy external control circuits.

CIRCUIT BREAKER RESET BUTTONS.

The reset buttons are grouped together on a panel (1, figure 1-5) on the inboard side of the right console. The button must be pushed in for operation of its respective circuit; of operation is desired without certain circuits, their applicable buttons may be pulled out.

INVERTER CHANGEOVER SWITCH.

This guarded switch (44, figure 1-5), located on the right console inboard of the battery switch, has two positions: #1 INV. and #2 INV. Normally, the switch is placed at its guarded #1 INV. position, wherein the No. 1 inverter supplies power to the G-2 compass, gyro horizon indicator, fuel flowmeter, and fuel quantity and oil pressure indicators. With the switch set at #1 INV. the No. 2 inverter powers certain circuits of the AN/APG-30 equipment. In the event of No. 1 inverter failure, as indicated by a glowing inverter warning light, raising the guard and setting the switch to #2 INV. automatically diverts the output of the No. 2 inverter to the equipment normally powered by the No. 1 inverter. This switch may also be used for testing the number two inverter by setting the switch at #2 INV. Successful changeover from the No. 1 to the No. 2 inverter is indicated by the inverter warning light remaining out.

FUSES.

Fuses (three groups—DC INST, INTERIOR LTS and AC INST) (11, figure 1-5) are installed on the outboard edge of the right console. They are installed for additional protection to certain circuits. Failure of a unit will not blow a fuse if there is no circuit overload. Failure will only cut out the portion of the circuit protected by fuses, and the remainder of the units on that circuit will remain operative.

SPARE FUSES.

Spare fuses are stored in a receptacle aft of the wing folding controls.

UTILITY RECEPTACLE.

A standard utility receptacle is mounted on the stabilizer power circuit breaker box to the right of the seat.

**EMERGENCY CONTROLS.**

The battery and generator switch should be left at BAT. & GEN. position for emergency operation. To operate equipment connected to the main d-c bus, such as radio, it is necessary to set the switch to BAT. To conserve electrical power, IT IS MANDATORY THAT ALL EQUIPMENT BE TURNED OFF when the switch is set to BAT.

**INDICATORS.**

VOLTAMMETER.

A dual dial, constant reading voltammeter (46, figure 1-5) is on the right console adjacent to the battery and generator switch. The meter indicates voltage at the main d-c bus and generator output amperage.

GENERATOR WARNING LIGHT.

A red generator warning light (42, figure 1-5), on the right console adjacent to the battery and generator switch, will glow in the event of generator failure, or if output is below battery potential.

INVERTER WARNING LIGHT.

When the inverter changeover switch is in its normal #1 INV. position, the red inverter warning light (43, figure 1-5), on the right console inboard of the battery switch will glow if the No. 1 inverter fails. When the inverter switch is set to #2 INV., the light will go out if the No. 2 inverter is producing ac.

## HYDRAULIC POWER SUPPLY SYSTEM.

### NORMAL CONTROLS AND OPERATION.

Fluid from the dual reservoir in the plenum chamber is pumped by a variable volume engine driven pump. The selector valve controls are in the cabin; most of the valves are outside the cabin and are operated through shafts and right angle drives. The power assist brake valves are on the brake pedals. The landing gear, wing folding, canopy, gun charging, arresting hook and tail skid, and speed brakes selector valves are in the forward section of the fuselage; these last three are electrically controlled. In addition to the system reservoir, a small reservoir is provided for the wheel brakes. Pressure is distributed via three manifolds, a service manifold, a combat manifold, and a flight manifold. A selector valve is also installed, which may be set to shut off pressure to all systems not essential to flight, for combat operation. The auxiliary hydraulic pump is powered by the airplane electrical system. See figure 1-2 for hydraulic fluid specification and figure 1-12 for system schematic diagram.

**Note**

Hydraulic fuses, actuated by flow, are installed in the system to prevent excessive loss of fluid in case of failure of lines and/or units. If a malfunctioning fuse should stop landing gear operation, the selector valve should be reversed momentarily to reset the fuse. (Fuse is installed in the landing gear up line only.)

#### HYDRAULIC SYSTEM CONTROL.

This control lever (25, figure 1-5) is on the right console, forward of the wing folding controls. It is moved outboard to HYDRAULIC PRESSURE OFF (combat operation), inboard to HYDRAULIC PRESSURE ON (normal operation—all hydraulic equipment operative). When the control is moved to HYDRAULIC PRESSURE OFF, only the following units are operative: flying tail, speed brakes, gun chargers, arresting hook, tail skid raising and flaperons or flaperettes. The following units are cut off when the control is moved to HYDRAULIC PRESSURE OFF to prevent loss of fluid due to damage to a non-essential system: canopy control, wing flaps, wing folding, wheel brakes and landing gear.

#### AUXILIARY HYDRAULIC PUMP SWITCH.

This toggle switch (23, figure 1-5), equipped with a guard, is on the right console aft, adjacent to the wing folding controls. It is set outboard to ON and inboard to OFF. If there is no action when some part of the system is operated, or if no pressure is indicated on the main system gage, the switch should be set to ON.

**CAUTION**

Do not use auxiliary pump on the ground without connecting external d-c power. Do not leave auxiliary pump switch at ON during flight.

**Note**

Auxiliary pump operation of any system will be considerably slower than normal operation.

### INDICATORS.

#### SYSTEM PRESSURE GAGE.

This gage (24, figure 1-5) is on the right console aft, adjacent to the map case. The dial shows pressure in psi, and is numbered from 0 to 2000. It should show 1500 psi when the engine is running and no hydraulic units are operating. Pressure indication may drop momentarily considerably below this figure when a system or systems are being operated.

#### AUXILIARY PUMP PRESSURE GAGE.

This gage (22, figure 1-5) is on the right console, aft of the system gage and forward of the auxiliary pump switch. The dial shows pressure in psi and is numbered from 0 to 2000. It should indicate aproximately 1700 psi with no hydraulic device operating, but may show very low readings, depending on the number of units being operated by the pump.

## FLIGHT CONTROL SYSTEM.

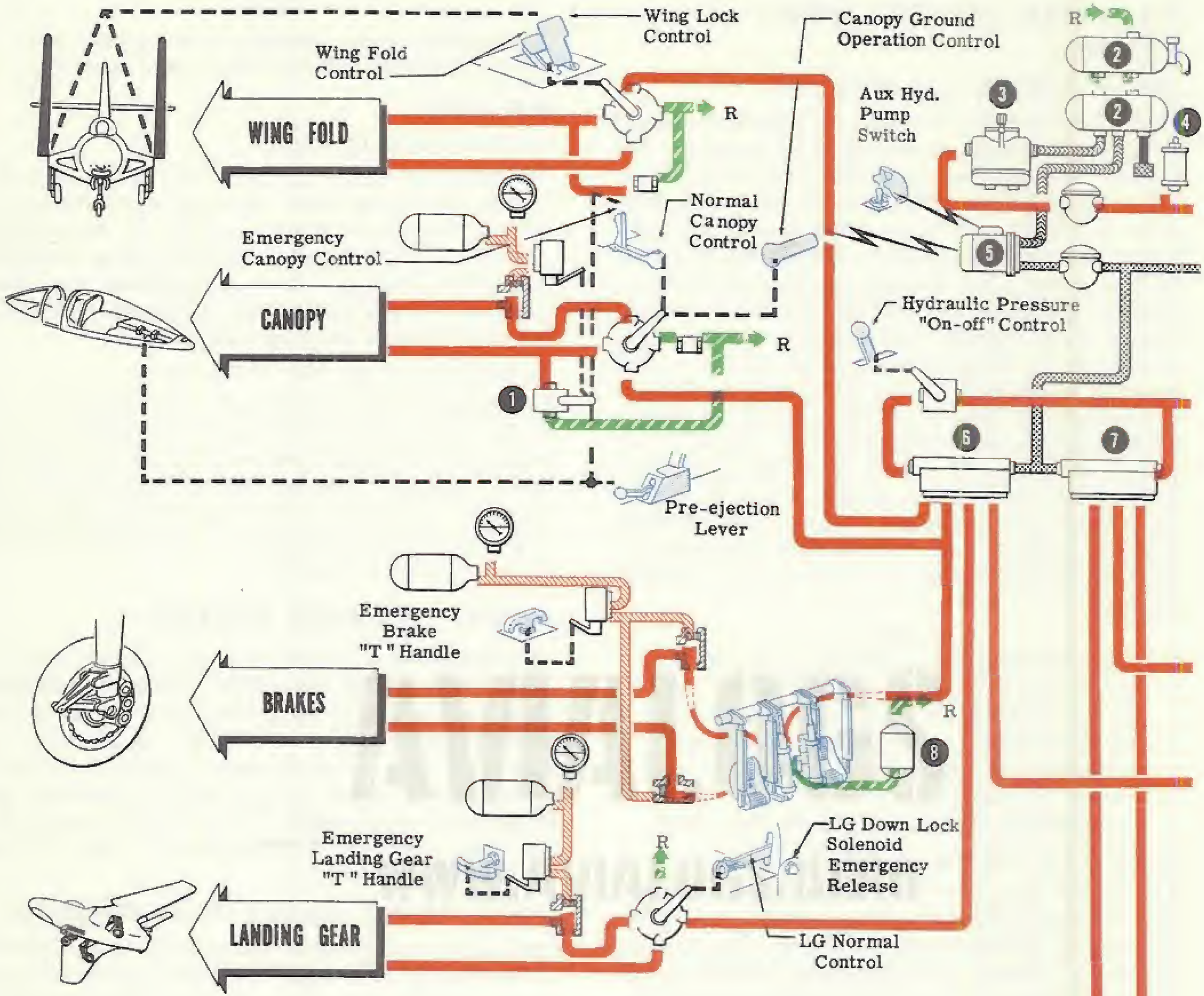
This airplane is controlled in the conventional manner, using a control stick and pedals. Lateral and longitudinal control is achieved by the use of flaperons and power operated stabilizer (flying tail) or manually controlled elevators. Flaps are used to facilitate low speed flight. Speed brakes are provided to decelerate the airplane at any airspeed. In addition, an adjustable stabilizer, a rudder trim tab system and a wing trimmer are installed for trim.

### NORMAL LATERAL CONTROL SYSTEM—FLAPERONS.

The control stick is linked hydraulically to the flaperon valves through push rods. The valves control the flaperons to provide lateral control. For normal operation, lateral movement of the control stick raises a flaperon from the wing surface. Hydraulic pressure to the flaperon valves and operating cylinders is derived from the engine driven hydraulic pump through the flight manifold.

### EMERGENCY LATERAL CONTROL SYSTEM—FLAPERETTES.

The aft halves of the flaperons are called flaperettes. The flaperettes are hinged to the flaperons and provide a reduced amount of lateral control when the flaperon system is inoperative. Normally, the flaperettes are locked in line with the flaperons and move as part of the flaperon surfaces. In the event of a hydraulic failure, the changeover to the flaperette system is automatic. This emergency system is essentially an independent hydraulic system which duplicates the operation of the normal flaperon system and includes an additional engine driven pump, a by-pass valve, a reservoir, an accumulator, relief valve, filter, operating valves and cylinders. As long as hydraulic pressure is available for the flaperon system, the by-pass valve is energized to remain




## Legend

1. Canopy Dump Valve
2. Reservoir (Top and Bottom)
3. Engine-driven Main Hydraulic Pump
4. Main System Accumulator
5. Electric Auxiliary Hydraulic Pump
6. Service Manifold
7. Combat Manifold
8. Brake Reservoir
9. Flight Manifold
10. Flaperon Hydraulic Pressure Sensing Switch
11. Vent and Relief Valve
12. Flaperette System Reservoir
13. Engine Driven Flaperette System Hydraulic Pump
14. Flaperette System Accumulator
15. Flaperette Emergency System Air Gage
16. Flaperette Emergency System Air Bottle
17. Flaperette Emergency System Air Pressure Control Valve
18. Flaperette Emergency System Accumulator
19. Flaperette System By-pass Valve
20. Flaperette System Relief Valve
21. Armament System Pressure Switches
22. Flaperon Shut-off Valve

## Code

Pressure
Return
Emer Flaperette Pressure
Emer Flaperette Return
Aux Pump Pressure
Pump Suction
Drain
Emergency Air
Check Valve
Release Valve
Shuttle
Filter

*Figure 1-12. Hydraulic System Schematic Diagram (Sheet 1 of 3)*

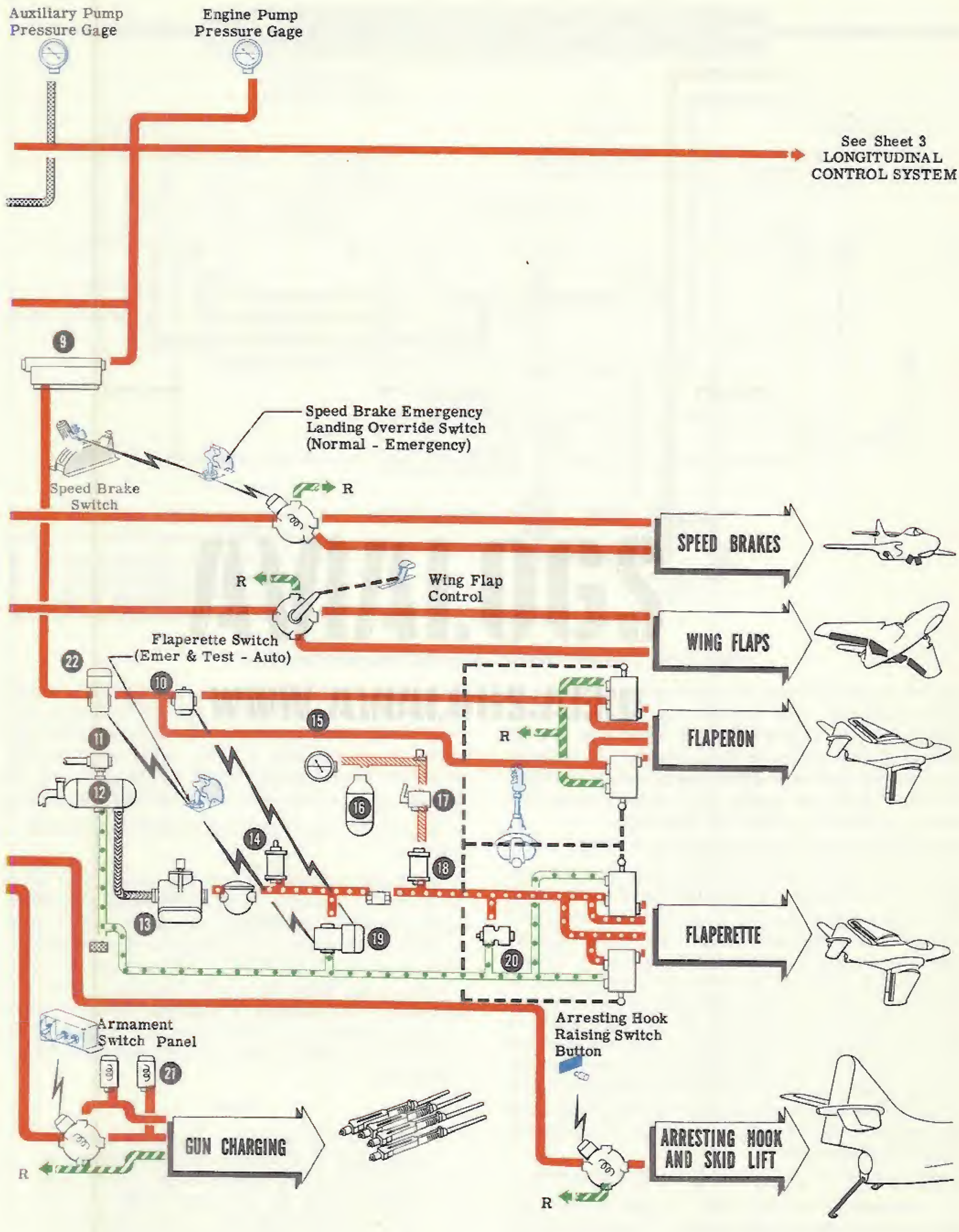



*Figure 1-12. Hydraulic System Schematic Diagram (Sheet 2 of 3)*

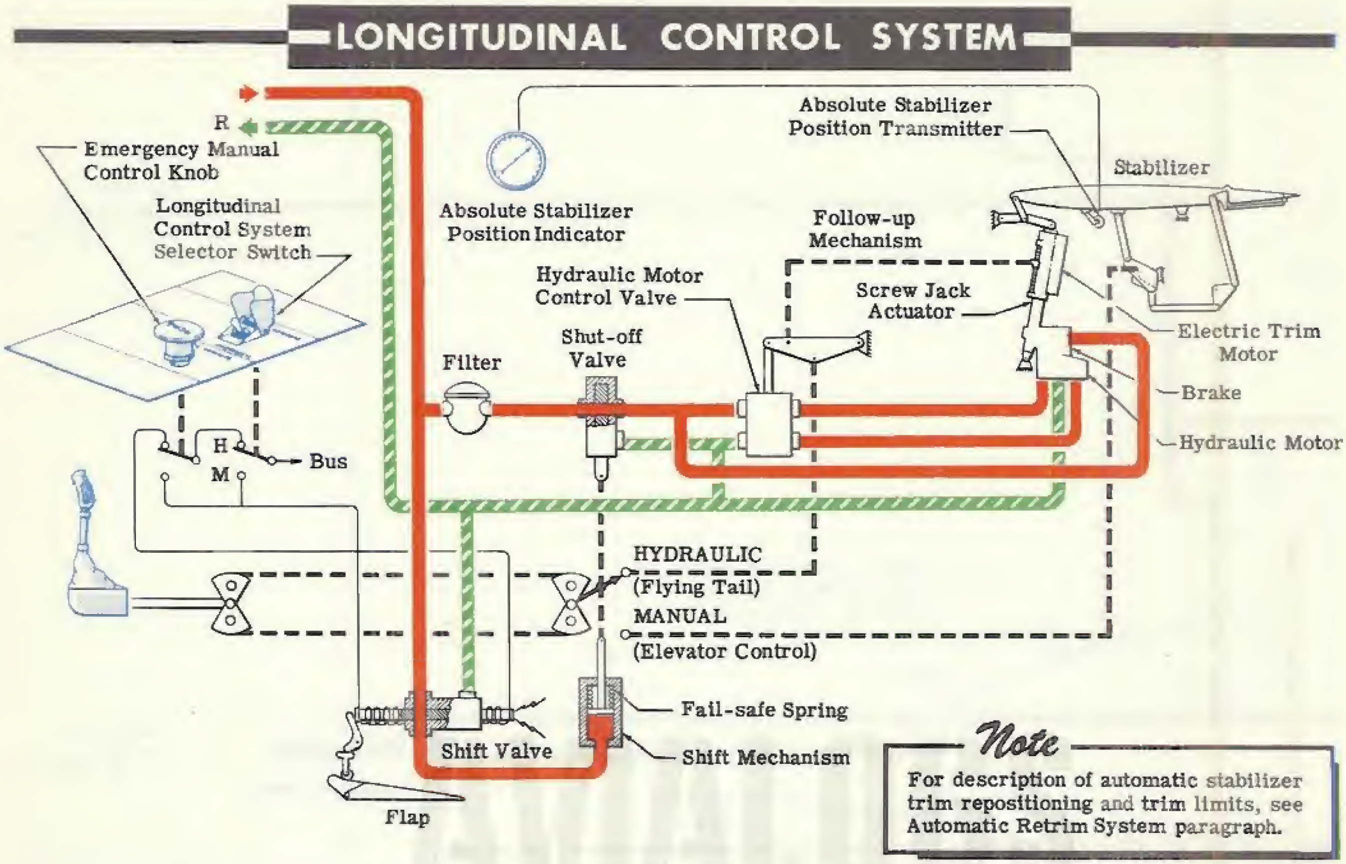



*Figure 1-12. Hydraulic System Schematic Diagram (Sheet 3 of 3)*

open to by-pass flaperette pump pressure to the flaperette system reservoir. The by-pass valve is closed either automatically by a pressure switch when there is a reduction of main system hydraulic pressure, or manually by setting the flaperette system control switch to EMER. & TEST. When the by-pass valve closes, it diverts hydraulic pressure to operate the flaperettes.

FLAPERETTE SYSTEM CONTROL SWITCH.

A two position guarded flaperette system switch (14, figure 1-5) is located on the right console. Normally, the switch is left in the AUTO. position, wherein lateral control will automatically change over to the flaperette system in the event of main hydraulic system failure. Moving the switch to its other position (EMER. & TEST) serves two purposes: primarily, it permits changing the lateral control over to the flaperette system in the event that automatic changeover does not occur due to the failure of the main hydraulic system pressure sensing switch; secondly, it permits the flaperette system to be checked for proper operation on the ground after the engine is started and also in flight for flaperette control familiarization.

EMERGENCY FLAPERETTE CONTROL SYSTEM.

The emergency flaperette control system provides the pilot with an increase in the number of flaperette operating cycles available during landing approach under flame-out conditions. The system is installed because the engine windmilling rpm at low airspeeds is too low to provide sufficient hydraulic pressure for proper control. This system includes an air bottle, an additional hydraulic accumulator, a check valve, an emergency flaperette power control handle in the cabin, an air pressure gage in the cabin and interconnecting tubing.

EMERGENCY FLAPERETTE POWER CONTROL LEVER.

This control is located on the left console (31, figure 1-3) and is actuated in a slot which has an ON detent and an OFF detent. Placing the control to ON opens a valve which releases air pressure to the accumulator. Pressurized hydraulic fluid in the accumulator is directed to the flaperette system operating valves and cylinders. The number of flaperette operating cycles is approximately 22. The control valve may be placed to OFF at any time to shut off air pressure to the accumulator.

**Note**

If use of the emergency flaperette system is anticipated, it is recommended that the system be tested at a safe altitude and turned off, then turned on for the emergency landing at the start of the final approach. If test is performed, the number of cycles remaining may be several less than 22.

AIR PRESSURE GAGE.

This gage is located on the left console (5, figure 1-3) and is calibrated in the number of flaperette operating cycles available. When the system is turned on with a fully charged air bottle, the gage needle will indicate that approximately 22 operating cycles are available. As the flaperette system is operated, the needle will move toward zero to show the number of available cycles remaining.

ARTIFICIAL FEEL.

Lateral stick forces are simulated by a cam-driven, spring loaded mechanism. The artificial feel thus induced in the lateral control system is necessary, since hydraulic operation of the flaperons and flaperettes relieves the stick of drag loads. To replace normal air load "feel", a cam attached to the artificial feel sector moves against a spring loaded arm, inducing a force in the system which opposes stick movement. This lateral force is independent of airspeed and is the same when either the normal flaperon system or the emergency flaperette system is being operated. Artificial feel is comfortable and amounts to 16 pounds for full stick travel.

**WING TRIMMER.**

The wing trimmer is a movable surface on the outboard end of the left wing provided to permit lateral trim. It is operated electrically by an actuator in the wing and controlled by left and right movement of the spring loaded thumb switch (15, figure 1-6) on the control stick.

**Note**

Fore and aft movement of this switch is used for stabilizer trim.

Holding the switch to the left causes the wing trimmer surface to rise and the left wing to lower. Movement to the right causes the trimmer to lower and the left wing to rise. The switch is spring loaded to return to the central (off) position.

**LONGITUDINAL CONTROL SYSTEM.**

Longitudinal control is provided by two separate systems. These are: the hydraulic pressure operated, all movable horizontal stabilizer control system for high speed clean configuration flight; and the manual elevator control system for low speed flight and emergency high speed flight. The shift from one system to the other is accomplished by either the normal or the emergency switch. An absolute stabilizer position indicator provides a means of checking stabilizer movement and position at all times.

FLYING TAIL (HYDRAULIC POWER OPERATED ALL MOVABLE HORIZONTAL STABILIZER) CONTROL SYSTEM.

The hydraulic pressure to operate the powered longitudinal control system comes from an engine driven pump. (See Hydraulic Power Supply System paragraph.)

The d-c power necessary to shift from one longitudinal control system to the other comes from the essential bus. The flying tail shift circuit breaker (22, figure 1-3), mounted on the stabilizer control selection panel, protects the longitudinal control system selector circuit.

On certain airplanes[1] the powered longitudinal control system may be activated in one of two ways: by moving the longitudinal control system selector switch to HYDRAULIC when the wing flaps are up (clean configuration), or by raising the wing flaps when the longitudinal control system selector switch has already been set to HYDRAULIC. In both cases, longitudinal control is transferred from a trimming stabilizer and movable elevator to a hydraulically operated flying tail. The flying tail moves up or down as the control stick operates a valve which controls extension or retraction of an irreversible screw jack attached to the stabilizer. Artificial feel is incorporated because there is no aerodynamic feedback in an irreversible control system. On the powered longitudinal control system, the elevators are geared to move slightly at a fixed ratio with the stabilizer. Their rigging is such that under all level flight conditions the elevators trail up.

On a few airplanes[2] the longitudinal control system selector switch has been removed and its function transferred to the longitudinal control system selector control. This white knob (27, figure 1-3) is pushed down for manual elevator control and pulled up for powered longitudinal control.

The travel of the stabilizer on powered longitudinal control is 6-1/2 degrees airplane nose-up and 4-1/2 degrees airplane nose-down from any given trim position, provided said travel is within the actuation limits. Thus, at 0 degrees trim the full travel of 6-1/2 and 4-1/2 degrees could be utilized. If the stabilizer is set at another trim, the travel is restricted. For example, if the stabilizer is positioned electrically to 2-1/2 degrees airplane nose-up trim, the stabilizer travel for full back stick will only be 4 degrees to the 6-1/2 degree absolute limit. For full forward stick the stabilizer would travel 4-1/2 degrees to an absolute position of 2 degrees airplane nose-down.

MANUAL ELEVATOR CONTROL SYSTEM.

The manual control system consists of the electrically operated stabilizer and standard mechanically controlled elevators. The airplane may, under normal conditions, be taken out of the powered longitudinal control system by moving the longitudinal control system selector switch to MANUAL, while remaining in the clean configuration (flaps up), or by lowering the flaps even though the longitudinal control system selector switch is at HYDRAULIC.

[1]Airplanes ser No. 131068 through 131070 and 131072 through 131074.

[2]Airplanes ser No. 131063 through 131067, 131071, 131075 and subsequent.

The longitudinal control system selector switch controls the shift by actuating the shift valve which controls the hydraulic pressure acting upon the shift mechanism. Actuating the flaps controls the same valve through mechanical linkage.

LONGITUDINAL CONTROL SYSTEM SHIFT.

The shift from one system to the other is accomplished by the shift mechanism on the aft control sector. The shift from manual to power control occurs in approximately 2-1/2 seconds. Hydraulic pressure holds the shift mechanism in the powered longitudinal control position by overcoming a fail-safe spring preloaded to force the shift mechanism to manual elevator control. Thus, when the longitudinal control system selector control is pushed down[1], or when the longitudinal control system selector switch is set to MANUAL[2], or if there is a loss of hydraulic pressure, the spring will cause a shift to manual elevator control.

LONGITUDINAL CONTROL SYSTEM SELECTOR CONTROL.[1]

The longitudinal control system selector control is a large white knob (27, figure 1-3) conveniently located on the inboard side of the stabilizer control selection panel on the left console. It is a two position push-pull electrical control that enables the pilot to select either (powered or manual) longitudinal control system. The knob is pushed down for manual elevator control and pulled up for powered longitudinal control (flying tail). When this control is pushed down, hydraulic pressure to all components of the powered longitudinal control system is shut off, and control is automatically shifted to manual operation.

LONGITUDINAL CONTROL SYSTEM SELECTOR SWITCH.[2]

The guarded longitudinal control system selector switch (25, figure 1-3) is located on the inboard side of the stabilizer control selection panel on the left console. The two positions of this toggle switch enable the pilot to select either longitudinal control system, MANUAL for manual elevator control, or HYDRAULIC for powered longitudinal control (flying tail). When this switch is placed in MANUAL, hydraulic pressure to all components of the powered longitudinal control system is shut off, and control is automatically shifted to manual operation.

EMERGENCY MANUAL CONTROL.[2]

A red push-pull knob (27, figure 1-3), labeled PUSH, is mounted on the inboard side of the stabilizer control selection panel on the left console. The emergency manual control knob provides a rapid means of shifting from the powered longitudinal control system to the manual elevator control system and attaining full electrical movement of the stabilizer. This knob normally remains in the up position, and must remain up for the powered longitudinal control system to be operable. The actual reversion to manual control is accomplished in the same manner as mentioned above; i.e., by shutting off hydraulic pressure to all the components of the powered longitudinal control system.

**Note**

> The control stick should be near neutral when shifting from powered to manual control. If the control stick is held aft when reverting to manual control, the stabilizer cannot return to its hydraulic neutral position before pressure is shut off. This will result in a brief out-of-trim condition if the powered control system is again selected.

ABSOLUTE STABILIZER POSITION INDICATOR.

This indicator (4, figure 1-4) is mounted on the upper left side of the instrument panel. It is calibrated in degrees to indicate absolute stabilizer position. The range of the indicator is 0 to 4-1/2 degrees airplane nose-down, and 0 to 6-1/2 degrees airplane nose-up. On the manual control system, the indicator always denotes the trim position of the stabilizer and will move only when the stabilizer trim setting is changed electrically. When operating on the powered longitudinal control system, the indicator continuously denotes the true stabilizer position and moves not only when the stabilizer trim adjustment is changed, but also whenever the control stick is displaced from neutral. Thus, when operating on the powered longitudinal control system, IT IS IMPORTANT TO REALIZE THAT THE ABSOLUTE STABILIZER POSITION INDICATOR DENOTES TRIM POSITION ONLY WHEN THE CONTROL STICK IS IN NEUTRAL AND NO FORE OR AFT CONTROL STICK FORCE IS BEING APPLIED.

ADJUSTABLE STABILIZER.

Longitudinal trim is controlled by switches through which the electric motor of the stabilizer actuator is energized. Trim is obtained through movement of the horizontal stabilizer by the electrically operated component of the actuator. The electric motor operates on d-c power from the essential bus. Limit switches in the stabilizer actuator restrict the stabilizer movement within the limits of its electrical adjustment range. On a few airplanes[1], the normal range is 6 degrees airplane nose-up and 1-3/4 degrees airplane nose-down. On other airplanes[2], the normal range is 2-1/2 degrees airplane nose-up and 1-3/4 degrees airplane nose-down with flaps up, and 6 degrees airplane nose-up and 1-3/4 degrees airplane nose-down with flaps down.

[1]Airplanes ser No. 131063 through 131067, 131071, 131075 and subsequent.
[2]Airplanes ser No. 131068 through 131070 and 131072 through 131074.

**Note**

The 6 degrees airplane nose-up and 1-3/4 degrees airplane nose-down limits are established by actual or absolute stabilizer position. Therefore, if the stabilizer is held away from these limits hydraulically while it is trimmed towards them electrically (pulling aft on the stick while trimming nose-down or vice versa), the trim limits can be exceeded and the trim can be run to the limit of actuator travel (6-1/2 degrees airplane nose-up or 4-1/2 degrees airplane nose-down).

AUTOMATIC RETRIM SYSTEM.[1]

The purpose of automatic retrim is to eliminate excessive airplane nose-up trim change when the flaps are retracted. When the flaps are being retracted, with a trim setting of more than 2-1/2 degrees airplane nose-up, the stabilizer will automatically be repositioned to 2-1/2 degrees airplane nose-up trim. Once the flaps are up, the airplane nose-up trim is limited to 2-1/2 degrees. The operation of the automatic retrim system is dependent upon the trim and longitudinal control systems selection. Automatic retrim and the 2-1/2 degree airplane nose-up limit is available only when the emergency manual control knob is in the normal (up) position, the electrical trim selector switch is set to NORM., and the flaps have been retracted or are being retracted. The 2-1/2 degree limit becomes 6 degrees when the emergency manual control knob has been depressed, or when the electric trim selector switch is set to EMERG. or when the flaps are lowered.

ADJUSTABLE STABILIZER TRIM CONTROLS.

ELECTRICAL TRIM SELECTOR SWITCH.

The guarded electrical trim selector switch (26, figure 1-3) is mounted on the stabilizer control selection panel on the left console. It has three positions, NORM., OFF, and EMERG. This switch permits the selection of the normal or the emergency trim circuits. In the NORM. position, the stabilizer is adjusted by the momentary thumb switch on the control stick grip. In the OFF position, neither the normal nor emergency circuit can be operated. In the EMERG. position, the stabilizer is adjusted by the emergency trim switch on the left console.

**Note**

Automatic retrimming[1] and the 2-1/2 degree airplane nose-up limit are not available if the electrical trim selector switch is set to EMERG.

NORMAL TRIM SWITCH.

The momentary thumb switch (15, figure 1-6) on top of the control stick grip is normally used to trim the adjustable stabilizer. It is moved forward for airplane nose-down trim, aft for airplane nose-up trim, and is spring loaded to return to the central (off) position.

**Note**

Lateral movement of this switch controls the wing trimmer.

EMERGENCY TRIM SWITCH.

In the event of an open or short circuit in the normal control circuit, the electrical trim selector switch should be set to EMERG. and the stabilizer position adjusted by using the emergency trim switch. This momentary type toggle switch (28, figure 1-3) is mounted on the stabilizer control selection panel on the left console. It is moved forward for airplane nose-down trim, aft for airplane nose-up trim, and is spring loaded to return to the central (off) position.

**RUDDER CONTROL SYSTEM.**

The rudder pedals are linked to the rudder by cables and push rods. The position of the rudder is determined by conventional movement of the pedals and also by the yaw damper system.

RUDDER TRIM TAB SYSTEM.

An electrically operated rudder trim tab on the lower portion of the rudder is provided for directional trim. The limit of tab travel is 5 degrees to the left and 5 degrees to the right. Limit switches in the system automatically shut off electrical power when the tab reaches the limits of its travel. The tab is controlled by a roatary switch on the left console. A rudder trim tab position indicator mounted on the left console shows the position of the trim tab.

RUDDER TRIM TAB CONTROL SWITCH.

This momentary rotary switch (29, figure 1-3) is marked NOSE LEFT and NOSE RIGHT and is mounted on the left console. The positions each side of neutral, as well as neutral, are off positions. Turning the switch to its extreme NOSE LEFT or NOSE RIGHT setting actuates the tab to obtain the desired directional trim.

RUDDER TRIM TAB POSITION INDICATOR.

This indicator (30, figure 1-3) is mounted on the left console. It is calibrated in degrees, with a range of 0 to 5 degrees nose left and 0 to 5 degrees nose right trim.

YAW DAMPER SYSTEM.

The electronic yaw damper system eliminates lateral-directional oscillations which are sometimes encountered in swept wing airplanes. These oscillations are apparent to the pilot as forms of snaking, Dutch roll, or wallowing. The yaw damper senses small yawing motions and automatically displaces the rudder to correct the disturbances before they become apparent to the pilot. The power requirements of the yaw damper system are 115 volt, 400 cycle, 3 phase ac for the amplifier and 28 volt dc for the servo unit motor. The ac is supplied by either inverter. The dc is supplied by the main bus and is controlled by the yaw damper power switch.

The yaw damper system consists essentially of two units: an amplifier and a rudder servo unit and the power

[1]Airplanes ser No. 131068 through 131070 and 131072 through 131074.

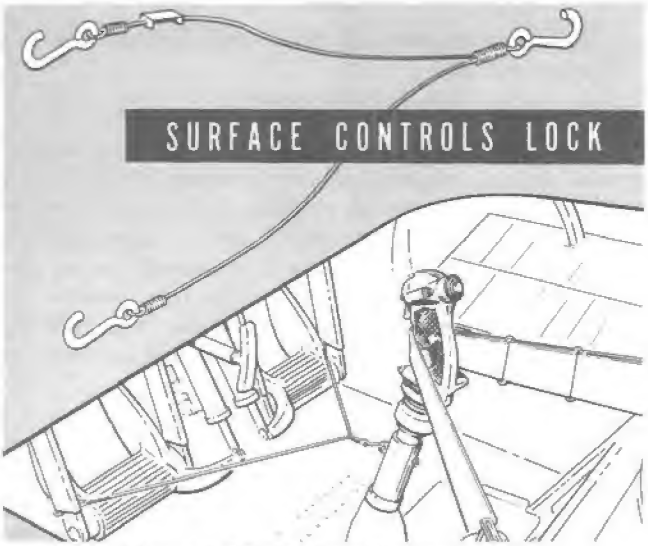



*Figure 1-13. Surface Controls Lock*

switch. The amplifier unit detects yawing velocity by means of a rate gyro and converts the mechanical displacement of the gyro into electrical signals. These signals are sent to the rudder servo unit, where the signals energize and also control the action of two clutches in the rudder servo unit. The rudder servo unit consists of the d-c motor, reduction geared to the two clutches which are geared to a common output shaft. This shaft drives a capstan connected to the rudder through cables. The rudder is deflected to correct the yaw disturbances detected by the rate gyro.

**Note**

The yaw damper indirectly activates the rudder-to-pedal cable system and causes the rudder pedals to move as the rudder is deflected by the yaw damper. This movement of the pedals may seem strange to the pilot on early familiarization flights, but will become virtually unnoticeable as the pilot gains experience in an airplane equipped with this system.

The yaw damper system is controlled by the pilot operated yaw damper power switch. In addition, there are two automatic cut-out switch arrangements which disconnect the yaw damper whenever its action conflicts with pilot effort. The yaw damper normally operates whenever the yaw damper power switch is in the ON position, except when it is disconnected by the cut-out switches. One set of cut-out switches is associated with the rudder pedals and disconnects the yaw damper whenever the pilot applies a force greater than 45 pounds on either or both rudder pedals. This permits the pilot to yaw the airplane intentionally for control in cross-wind take-offs or landings.

**Note**

Pilots are cautioned not rest their feet on the rudder pedals during straight flight so heavily that the 45 pound cut-out switches keep the yaw damper continuously disconnected.

The other set of cut-out switches is associated with lateral motion of the stick, and disconnects the yaw damper whenever the stick is displaced more than 1-1/2 inches from neutral. The yaw damper remains disconnected for two seconds after the stick has been returned to the 1-1/2 inch band on either side of neutral. This lateral cut-out feature allows a turn entry or roll reversal, permitting an intentional turn entry away from an established flight path. Since the yaw damper may be temporarily disconnected by lateral motion of the stick during a turn entry or roll reversal, appropriate rudder should be used to coordinate these maneuvers exactly as though no yaw damper were installed.

YAW DAMPER POWER SWITCH.

This OFF-ON switch (7, figure 1-5) is mounted on the right cabin rail just below the windshield frame. The yaw damper system is made operative by setting the yaw damper power switch to ON. This completes the circuit between the main bus and the rudder servo unit d-c motor.

## SURFACE CONTROLS LOCK.

The controls are locked by utilizing the pilot's harness and a cable assembly. The harness is used to secure the control stick and the cable assembly is attached to each rudder pedal and secured to the control stick (figure 1-13).

## FLAPS.

The flaps are hydraulically operated and are controlled by a lever (11, figure 1-3) on the left console. They can assume either of two positions, up or down. The down position is used for both take-off and landing. Flap surfaces are on the trailing edge of each wing and beneath the fuselage. The wing flaps are referred to as outboard flaps and the fuselage flaps as the inboard flaps.

FLAP CONTROL LEVER.

The two flap control lever positions are marked DOWN and UP. When the lever is moved to DOWN, a valve is opened which directs hydraulic pressure to the flap actuating cylinders. The cylinders move both the inboard and outboard flaps to their full down position, which is 40 degrees for the inboard flaps and 22 degrees for the outboard flaps. No intermediate flap setting can be made. Moving the flap control to UP raises the flaps.

**Note**

To actuate the flaps, first move the flap control lever inboard to free it from its detent before attempting to select the DOWN position.

FLAP POSITION INDICATOR.

The flap position indicator (44, figure 1-4) is incorporated in a combination wheels and flaps position indicator mounted on the left side of the instrument panel. When electric power is on, a miniature flap appears in the window in a position corresponding to the posi-

tion of the wing flaps. When the instrument is de-energized normally or by instrument or power failure, the word OFF appears in a window on the upper portion of the dial face.

### SPEED BRAKES.

The hydraulically operated speed brakes are installed beneath the fuselage and on the trailing edges of the inboard flaps and have a limit extension of 75 and 40 degrees, respectively. The speed brakes may be extended to any intermediate position but cannot be extended or retracted separately. In the event of an electrical power failure with the speed brakes down, they will retract automatically.

One airplane[1] has an automatic g-Mach number limiter switch installed in the speed brakes control system. At a combination of .95 true Mach number and 1-1/2g or higher, this switch will automatically raise the speed brakes. If speed brakes are selected while flying in the region of .95 true Mach number and 1-1/2g or above, they will remain retracted until the airplane decelerates to below .95 true Mach number or is pulling less than 1-1/2g.

**Note**

When the speed brakes emergency landing override switch is set to its emergency position, the g-Mach number limiter switch is by-passed.

#### SPEED BRAKES NORMAL CONTROL.

The speed brakes are controlled by a three position toggle switch (44, figure 1-3) on the inboard side of the throttle quadrant. Moving the switch to UP or DOWN energizes a solenoid valve which directs hydraulic pressure to the speed brake cylinders. Hydraulic pressure will keep moving the speed brakes as long as the switch is in a selected position (UP or DOWN) and will stop when the switch is released (to off) or when they reach the limit of their travel. The switch is momentary in the DOWN position.

**Note**

Normally, the landing flaps and speed brakes cannot be down simultaneously. If the flaps are extended while the speed brakes are down, the latter will retract automatically. However, for a wheels-up emergency landing, the speed brakes can be extended by the normal control when the landing flaps are extended, by first operating the speed brakes emergency landing override switch. (See Speed Brakes Emergency Landing Override Switch paragraph.)

A reset type circuit breaker (43, figure 1-3) is mounted on the left console outboard of the normal control. The circuit breaker must be in to extend the speed brakes. If the speed brakes circuit breaker will not stay set, check that speed brakes switch is in off position.

#### SPEED BRAKES EMERGENCY LANDING OVERRIDE SWITCH.

This two position, guarded toggle switch (33, figure 1-3), mounted on the aft portion of the left console, is safety-wired in the normal position. In the normal position, speed brakes will be raised automatically whenever the landing flaps are lowered. Breaking the safety wire, raising the guard and setting the switch to the emergency position, with landing flaps down, permits the speed brakes to be lowered using the normal speed brakes control switch. This procedure permits lowering both the flaps and speed brakes in an emergency such as a wheels-up landing.

#### SPEED BRAKES POSITION INDICATOR.

A speed brakes position indicator (3, figure 1-4) is installed on the left side of the instrument panel. When the speed brakes are fully retracted, the word UP appears on the indicator. When the speed brakes are in any intermediate position or full down, the word DOWN appears on the indicator. A barber pole flag appears on the dial face when power to the indicator is cut off.

## LANDING GEAR.

### NORMAL CONTROL.

The landing gear control (45, figure 1-4), a two position lever operating a hydraulic selector valve, is on the instrument panel bulkhead forward of the left console. When the lever is moved to DOWN, after releasing the "T" latch, hydraulic cylinders open the wheel doors, lower and lock down the main and nose wheels and then close the main wheel doors again. The doors are operated by separate cylinders. When the lever is moved to UP, action is reversed and special locking cylinders lock the main wheels in the up position. A solenoid operated latch is installed to prevent inadvertent wheel retraction when the airplane is on the deck. When airborne, the struts extend, releasing the latch which permits moving the control lever to UP. Extension or retraction of the landing gear may be accomplished by the normal control, using the auxiliary hydraulic pump in the event of normal hydraulic pump failure.

**Note**

When the landing gear control handle is moved to DOWN, the guns are rendered safe.

### EMERGENCY CONTROLS.

#### EMERGENCY EXTENSION CONTROL HANDLE.

A red "T" handle (1, figure 1-4), just outboard of the normal control, when pulled out, actuates a cable to open a compressed air bottle and direct air pressure to the cylinders to open the doors and lower and lock the wheels (and again close the main wheel doors). The handle shaft is notched to provide a lock when it is pulled out to the release position. IT MUST BE LOCKED WHEN PULLED TO THE RELEASE POSITION.

[1]Airplane ser No. 131065.

**Note**

Airspeed must be reduced to 130 knots before using emergency control. Once the emergency control has been used, the gear must not be retracted until normal operation has been restored by a deck crew reservicing the systems.

**WARNING**

In a situation which requires emergency landing gear extension, on airplanes which have Aircraft Service Change 217 incorporated, an effort should be made to lower the flaps prior to landing gear extension.

The normal hydraulic system pressure will be dumped to the return line when the emergency extension control handle is pulled.

DOWN LOCK SOLENOID RELEASE.

A thumb operated release knob (43, figure 1-4) is located just forward of the instrument panel bulkhead on the left side, just inboard of the normal control. If electrical failure should make the down lock solenoid inoperative, pushing the knob outboard will clear the control lever to raise the gear for a wheels-up landing.

#### INDICATORS.

WHEELS AND FLAPS POSITION INDICATOR.

A standard indicator (44, figure 1-4), which shows wheels down and locked or wheels up and locked is on the left side of main instrument panel.

LANDING GEAR UNLOCKED WARNING LIGHT.

A red light in the translucent handle of the landing gear control lever (45, figure 1-4) glows when the gear is not locked in the up or down position.

## BRAKES.

#### NORMAL CONTROLS.

The brake pedals operate power assist brake valves (mounted on the pedals) to control hydraulic pressure to the disc type brakes. A special hydraulic reservoir (connected to the main system) is installed for the brakes so that brake operation is available in the event of hydraulic system failure.

#### EMERGENCY CONTROL.

The emergency brake red "T" handle (32, figure 1-3) is on the left console, aft. The handle is pulled up to release and inboard to lock (the handle shaft is notched to provide a lock for the release and lock position). When pulled, the handle actuates a cable to open a compressed air bottle which acts on the brake cylinders.

**Note**

Once the emergency "T" handle is used, the brakes are set full on. Release and the return to normal operation must be effected by a deck crew.

## ARRESTING HOOK.

#### NORMAL CONTROLS.

HOOK DOWN AND BARRIER GUARD CONTROL.

The hook control (27, figure 1-4), on the instrument panel bulkhead forward of the right console, operates a chain and cable assembly to the hook and a cable assembly to the barrier guard. The hook rides on a carriage and roller assembly and the control must be pulled and released repeatedly (three or four times) until the hook is fully extended and locked down. The barrier guard is a spring loaded square tube which, when the control handle is pulled, projects up from the fuselage just forward of the windshield. A switch on the release lowers the tail skid when the hook is lowered. The hook and barrier guard must be restowed by the deck crew.

**CAUTION**

When test operating the system, insure that personnel are clear of the hook and barrier guard.


HOOK UP CONTROL.

This push button switch (28, figure 1-4), is on the instrument panel bulkhead forward of the right console, adjacent to the hook down and barrier guard control. When the button is pushed, a solenoid operated hydraulic valve is actuated to direct pressure to a single action cylinder which raises the hook clear of the deck to permit taxiing forward of the barrier and arresting cables. (This cylinder action retracts the tail skid simultaneously through a cable linkage.)

**Note**

The hook up push button switch will raise the hook only when the landing gear control is in the DOWN position.

#### INDICATORS.

HOOK POSITION WARNING LIGHT.

A red press-to-test warning light (25, figure 1-4) on the main instrument panel bulkhead forward of the right

console glows when the hook is in any intermediate position between full up and full down. The light goes out when the hook is either fully extended or retracted.

APPROACH LIGHT.

When the wheels are down and locked and the hook is lowered, the approach light is lighted (steady); if the wheels are down and locked and the hook is NOT lowered, the approach light flashes.

**TAIL SKID.**

The skid is interconnected mechanically with the arresting hook. The hook raising cylinder raises the skid through a cam and cable arrangement and the skid is lowered when pressure to the cylinder is released. Pressure to the cylinder is controlled by a solenoid valve operated by switches as follows:

a. A switch on the landing gear control causes the cylinder to extend and raise the skid when the gear is raised and releases pressure from the cylinder to cause the skid to lower when the gear is lowered.

b. A limit switch actuated by the throttle is utilized to raise the skid when the throttle is moved full forward to OPEN and to lower the skid when the throttle is retarded to 90 per cent power when the landing gear control is at DOWN.

c. A switch on the arresting hook release overrides both the landing gear control and the throttle switches to lower the skid when the hook is lowered.

d. The hook raising switch button, when pressed to raise the hook from the deck after landing, also raises the skid.

TAIL SKID CONTROL SWITCH.

A tail skid control switch (6, figure 1-5), on the main instrument panel bulkhead forward of the right console, equipped with a guard, is provided for catapult take-off. When set to DN, after clearing the guard, the throttle actuated skid raising switch is overridden and the skid remains down until the landing gear is raised.

## WING FOLDING.

**NORMAL CONTROLS.**

The folding and locking control levers assembly (20, figure 1-5) is on the aft end of the right console. The levers lie flush with the console when the wings are spread and locked. The control is operated by pushing down on the plate marked PUSH with the index or second finger and lifting the outer lever up to disengage the safety locks on the wing lock cylinders. A detent on this outer lever then clears the inner lever so it can be lifted up to unlock the wing lock cylinders and to fold the wings. The inner lever is pushed down into the console to spread and lock the wings and the outer lever is pushed down flush with the console to engage safety locks on the lock cylinders.

**WARNING**

Do NOT force the outer lever into the locked position if the normal amount of force does not permit the lever to go down. This may be an indication that the wing fold hinge lock pin is not in the locked position.

The inner lever operates a hydraulic selector valve to actuate folding and locking cylinders (one each—left and right). When pushed down (spread), timer check valves open after the folding cylinders are fully retracted to permit pressure to actuate the lock cylinders. In the folding action (levers lifted), timer check valves permit pressure to flow to the folding cylinders after the locking cylinder pistons have been withdrawn.

**CAUTION**

Make certain the wing lock lock (outer) control lever is moved through its limit of travel before operating the wing folding (inner) control lever.

Never leave the wing folding control lever in an intermediate position between its wing folded and wing spread positions.

The wing folding or spreading cycle must be completed before reversing the direction of wing movement.

After wings are folded, it is recommended that wing fold jury struts be inserted before the engine is shut down.

Before spreading wings, insure that dump valves are closed.

The outer control lever of the assembly, when pushed down, actuates a cable and bellcrank linkage which rotates notched pins to block the locking cylinder pistons in the locked position and pulls the red signal vanes out of sight when the pins are in place. When the control is lifted up, the pins are rotated to clear the lock cylinder pistons for withdrawal (unlock) and the signal vanes appear.

**INDICATORS.**

Red signal vanes are installed on the upper surface of the wing stub leading edges just inboard of the folding axes. When the wings are spread and locked, the vanes are drawn out of sight of the pilot and into the wings by mechanical action, through cables and bellcranks from the locking control. When the wings are unlocked, the vanes protrude from the wings and are visible to the pilot.

## INSTRUMENTS.

The majority of the instruments are installed on the main instrument panel (figure 1-4). They can be classified into three groups: flight instruments, engine

instruments and miscellaneous instruments. In the flight instrument group, the altimeter, rate of climb indicator, and airspeed indicator operate from the pitot static system; the turn and bank indicator, from engine compressor bleed air. The G-2 remote compass and gyro horizon indicator are powered by ac supplied by the inverter system. The radio compass is d-c powered from the main bus. In the engine instrument group, the tailpipe temperature indicator light is d-c powered from the main bus. The fuel quantity indicator is powered by dc from the main bus and ac from the inverter system. The fuel flowmeter and oil pressure indicator are powered by ac from the inverter system. The tachometer indicator is powered by ac from a self-contained source (tachometer generator). The miscellaneous group of instruments comprises the wheels and flaps position indicator, the speed brakes position indicator, the absolute stabilizer position indicator, and the rudder trim tab position indicator, which are powered by dc from the essential bus. Included in this group are the accelerometer, which is internally mechanical, and the Bourdon tube type hydraulic pressure gages.

### G-2 REMOTE COMPASS.

The G-2 compass (35, figure 1-4) combines the advantages of the remote indicating compass and the gyro compass into one instrument, thus providing a stabilized gyro compass reading. It also corrects automatically for drift, and eliminates oscillation and northerly turning error. A correspondence dial, located in the center of the master compass indicator, gives an unstabilized remote compass reading, and the outer dial gives a stabilized gyro compass heading, free from drift. Magnetic heading information is fed by the G-2 compass to the course indicator where the information is displayed on the compass card. A selector switch (36, figure 1-5), located on the electrical control panel on the right console, provides compass slaving of the instrument or permits its use as a free directional gyro. (See Navigation Equipment paragraph. Section IV, for operation.)

### AIRSPEED AND MACH NUMBER INDICATOR.

The airspeed and Mach number indicator (37, figure 1-4) is located on the instrument panel in the upper row of instruments to the left of the center line. The indicator is a combination instrument, connected to both static and pitot pressure lines, consisting of an airspeed mechanism and an altitude mechanism. The indicated airspeed mechanism drives a pointer to indicate airspeed on a fixed dial. The pointer also indicates the Mach number on a movable Mach number scale which is driven by the altitude mechanism.

The gearing between the moving scale and the altitude mechanism is such that the Mach number will be indicated by the pointer on the moving scale at any combination of indicated airspeed and altitude within the range of the instrument. The airspeed indicator has a range of 80 to 650 knots and the Mach number scale has a range of 0.50 to 2.0. The indicator has two triangular indexes, a Mach number setting index and an airspeed setting index. The setting of the Mach number index and the airspeed index is made by the adjustment knob located in the lower left corner of the bezel. The Mach number index is set by depressing and turning the knob and setting the index to the desired Mach number. The Mach number index is not necessarily set at the limit Mach number of the airplane. It is for the pilot's convenience in flying any constant Mach number within the airplane limitations. The airspeed indicator index is set by turning the knob, without depressing it, and setting the index to any desired airspeed within its range of 80 to 145 knots.

**Note**

Either index can be set without changing the setting of the other index.

The following two conditions are given as examples of the operation of the indicator. As the airplane ascends at a constant airspeed, the pointer will remain stationary and the Mach number scale will rotate, indicating an increasing Mach number. As the airplane ascends at a constant Mach number, the Mach number scale and the pointer rotate, with the pointer maintaining its position on the Mach number scale, indicating a constant Mach number and decreasing airspeed. This is due to the fact that the equivalent speed of sound decreases with increasing altitude.

### GYRO HORIZON INDICATOR.

A gyro horizon indicator (33, figure 1-4) is located on the upper row of the main instrument panel to the right of the center line. This instrument provides an immediate indication of the airplane's attitude when properly erected.

This indicator has a pitch scale visible through a rectangular window located in the center of the instrument face. The pitch scale has a range of 0 to 80 degrees for indicating both positive and negative pitch attitudes.

#### OPERATION.

Quick erection of the gyro horizon indicator is accomplished by a mechanical device which is actuated by the pull to cage knob on the instrument bezel. This knob must be pulled out to its mechanical stop immediately after the battery switch is set to BAT. & GEN. and held in that position until the horizontal and banking index bars cease to oscillate, at which time they should indicate 0 pitch and 0 roll, within approximately 3 degrees. The time required to hold the caging knob out before the index bars stabilize depends upon the position of the gyro; however, the longest time will be approximately 10 seconds. By means of the small knob on the left side of the bezel, the miniature airplane may be raised or lowered for any desired fore-and-aft attitude of the airplane. When the battery switch is set to OFF, or if there is a partial or complete power failure, an OFF flag will appear on the dial face.

CAUTION

Do not erect the gyro horizon indicator in flight unless the airplane is flying straight and level, or the gyro will give an incorrect indication.

#### STAND-BY COMPASS.

On early airplanes[1] the stand-by compass (19, figure 1-4) is mounted above the instrument panel to the right of the sight unit. On later airplanes[2] the stand-by compass is mounted on the windshield bow and a light switch is mounted on the windshield deck.

CAUTION

If it becomes necessary to use the stand-by compass[2] when the gun sight recording camera is installed, disconnect the electric cable, remove the camera from the mounting bracket, and stow it in the map case.

Two correction cards are mounted below the instrument panel to the right of the center line. One card shows compass calibration for normal operating condition with all equipment in operation; the second card gives the calibration with the battery and generator switch in the OFF position.

## CANOPY.

### NORMAL CONTROLS.

#### CANOPY CONTROL—NORMAL HYDRAULIC.

This handle is on the left side of the cabin, just forward of the canopy track. The handle is moved forward to close the canopy and aft to open the canopy. The control handle (17, figure 1-3) operates a selector valve to actuate a hydraulic cylinder on the fuselage deck to move the canopy forward and aft.

CAUTION

Do not return canopy control handle to neutral when canopy is moved to either full open or full closed.

Keep head and hands inside canopy during operation. If canopy does not close fully, it indicates faulty latching. Do not open in flight above limiting airspeed except in an emergency, as it may be lost.

#### CANOPY CONTROL—GROUND OPERATION.

This lever is on the left side of the fuselage aft of the line of the seat armor plate, just below the edge of the canopy. The control is operated by pressing in the forward end with the thumb and then rotating the handle up to OPEN or down to CLOSED. The lever actuates a switch to start the auxiliary hydraulic pump and operates the selector valve to direct pressure to the canopy cylinder.

WARNING

See that personnel are clear of flaps and speed brakes when operating canopy ground operation control.

### EMERGENCY CONTROL.

The normal canopy control described above incorporates an emergency open canopy control lever. Folding this handle (16, figure 1-3) into a slot in the normal control handle permits the entire control assembly to be moved beyond OPEN and into the emergency opening position. This releases air pressure from an air bottle system into the canopy control hydraulic cylinder to open the canopy.

### CANOPY GROUND RELEASE.

The canopy may be removed by using the handgrip on the aft end. Pressing down the handgrip unlatches the canopy from the actuating cylinder.

## PILOT'S EJECTION SEAT.

### NORMAL CONTROLS.

#### SEAT HEIGHT CONTROL.

Seat height is adjusted by an electrical actuator controlled by a momentary switch (1, figure 1-6) with a center (off) position, mounted on the right side of the seat. The two momentary positions are DOWN and UP.

#### HARNESS LOCK.

The harness inertia reel lock is mounted on the forward left side of the seat. The lever (11, figure 1-6) is moved AFT TO SLACK OFF the harness in order to lean forward, etc; the lever is moved FORWARD TO LOCK the harness.

### EMERGENCY CONTROLS.

#### PRE-EJECTION LEVER.

This lever (10, figure 1-3) is on the left side of the cabin below the canopy track. It is PULLED INBOARD AND PUSHED DOWN to operate and then PUSHED OUTBOARD TO LOCK. When the lever is operated, the canopy is jettisoned (by pressure from an air bottle), the knee braces on the seat sides are moved up into position, and the arming pin is pulled.

WARNING

The lever MUST BE PUSHED OUTBOARD TO LOCK DOWN.

[1]Airplanes ser No. 131063 through 131074.

[2]Airplanes ser No. 131075 and subsequent.

EMERGENCY EJECTION SEAT ARMING CONTROL.

An emergency ejection seat arming control (6, figure 1-6) is provided because under certain extreme flight conditions, such as high negative "g", it may be difficult to reach and actuate the pre-ejection lever. For this condition, or one where the canopy fails to jettison, using the emergency ejection seat arming control will permit ejection through the canopy. This control is a red handle on the left side of the headrest and is attached to the cable which normally pulls the arming pin in the seat catapult firing mechanism. Pulling the control forward past the pilot's left ear pulls the arming pin and arms the seat . It does not release the knee braces. For this type of ejection, hold knees together to prevent injury.

**WARNING**

Ejection through the canopy is feasible only with the canopy in the fully closed position.

SEAT CATAPULT FIRING CONTROL (FACE COVER HANDLE).

This handle (4, figure 1-6) is just above the pilot's headrest and is attached to the face cover which is stowed on a roller behind the headrest. After operating the pre-ejection lever, the pilot slides his feet aft onto the stirrups, sets his knees against the braces and pulls the handle forward and down to bring the face curtain over his face. This action locks the inertia reel and fires the charge to eject the seat from the airplane. The seat is ejected from the airplane by the catapult unit, which consists of two mated tubes and an explosive charge. The inside tube is attached to the cabin floor. The outside tube, which carries the charge, is attached to the seat back.

## AUXILIARY EQUIPMENT.

The following systems are discussed in Section IV:

Cabin Air Conditioning System
Communication and Associated Electronic Equipment
Lighting Equipment
Oxygen System
Navigation Equipment
Armament
Armament Control System
Gun Camera
"G" Suit Equipment


## BEFORE ENTERING THE AIRPLANE.

a. See Section V for limitations imposed on this airplane.

b. Use the operating data contained in the Appendix to determine the required fuel airspeed and power settings necessary to complete a mission.

c. Determine weight and balance status of airplane:— Obtain take-off and anticipated landing gross weights. Have useful load checked. Be sure proper ammunition load or ballast is aboard.

**Note**

Refer to the Handbook of Weight and Balance, AN 01-1B-40, for loading information.

### EXTERIOR INSPECTION.

Consult Yellow Sheet for status of airplane and make sure airplane has been properly serviced. For complete exterior inspection, see figure 2-1.

### ENTRANCE.

For instructions on entering the airplane, see figure 2-2.

**CAUTION**

The boarding ladder cannot be stowed from the cabin. Before flight, insure that it is properly stowed by the ground crew.

### CANOPY AND EJECTION SEAT CHECK.

Before becoming seated in the airplane, check canopy for normal position (not jettison position). Check ejection seat for proper attachment of arming pin cable.

## ON ENTERING AIRPLANE.

### INTERIOR CHECKS—ALL FLIGHTS.

a. All switches off or safe (gun switches).

b. Remove controls lock (bridle) and stow.

c. Control stick and pedals for free movement and for full throw.

d. Oxygen ON (oxygen supply control at regulator). Check equipment.

e. External power sources connected (check with ground crew).

**Note**

There are three external power receptacles: engine starting, general equipment and electronic testing.

f. Clock set.

g. Altimeter set.

h. Cabin clear, everything stowed; seat belt and shoulder harness fastened; oxygen, "G" suit, and radio leads attached.

i. "G" suit valve HI or LO, as desired.

j. All circuit breakers in.

k. Battery switch—BAT. & GEN. Check battery voltage (21 volts minimum).

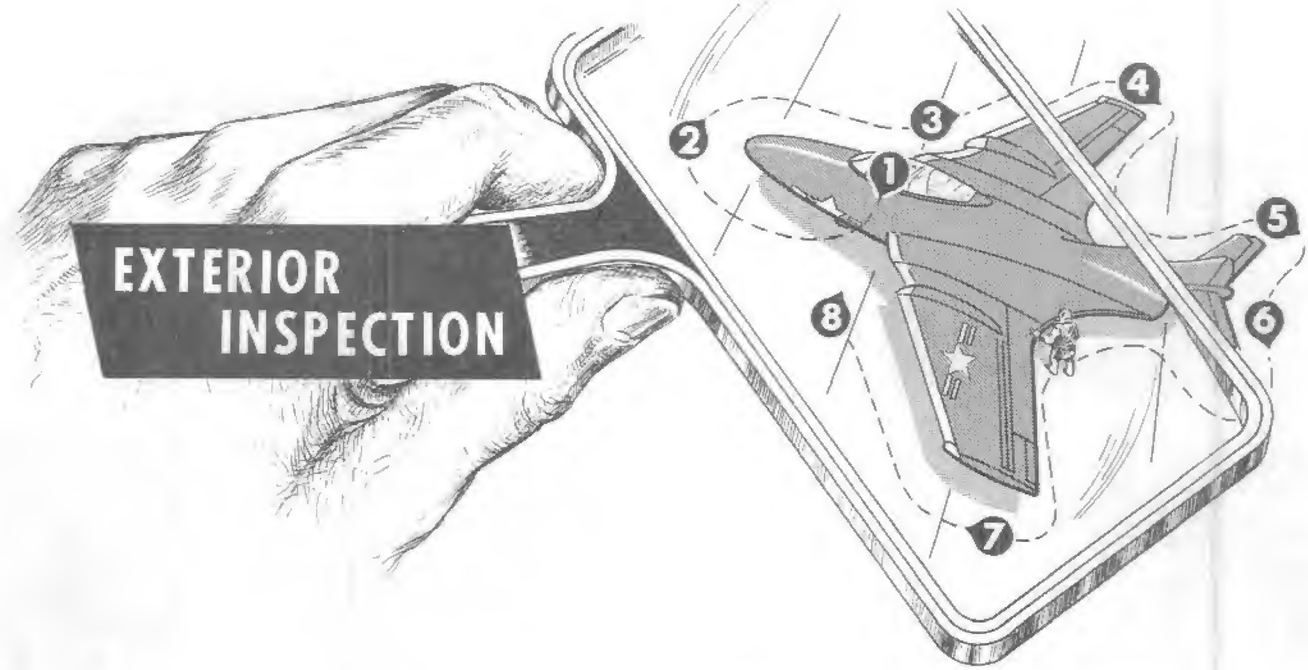
l. Check landing gear down and locked.

m. Pitot heater switch—ON (if necessary).

n. Fuselage sliding nose locked (warning light out).

o. Check all press-to-tests lights.

p. G-2 compass control set to COMPASS CONTROL.




## 1 CABIN

a. Ejection seat arming pin cable attached.
b. All switches off.
c. Controls unlocked.
d Control bridle stowed.

## 2 NOSE

a. Overall view of airplane.
b. Landing gear chocked.
c. Overall view of nose gear indicates no obvious defects.
d. Nose gear tire and shock strut properly inflated.
e. Check nose for positive lock and air bottles in nose wheel well for proper pressure.
f. Left and right gun barrels unplugged.

## 3 FUSELAGE - RIGHT SIDE

a. Access doors closed.
b. Intake duct unplugged.
c. Overall view of main landing gear indicates no obvious defects.
d. Main gear tire and shock strut properly inflated.
e. Speed brakes full up.
f. Inboard flaps and speed brakes hinge points and contour flush with fuselage and wing stub.

## 4 RIGHT WING

a. Overall view of wing upper and lower surfaces indicated no washboarding, wrinkles or cracks.
b. Wing fuel tank filler cap and door secure.
c. External stores secure. Filler cap on droppable fuel tank secure.
d. Navigation lights undamaged.
e. Flaperon full flush.
f. Flaperon hinge points secured and safetied.
g. Flap full up (no trail). Hinge points secured and safetied.
h. Wing fairings in place.
i. Wing tank dump port unplugged.

## 5 STABILIZER

a. Overall view indicates no wrinkle or cracking.
b. Elevators move freely. Hinge points secured and safetied.
c. Elevator tab hinge points secured and safetied.
d. Elevator tab play - no noticeable play permissible.
e. Stabilizer fairings intact, screws in place and no deformation of fairing itself.

## 6 TAIL SECTION

a. Overall view of fin and rudder indicates no wrinkle or crack.
b. Rudder moves freely. Hinge points secured and safetied.
c. Rudder trim tab no noticeable play permissible.
d. Navigation lights undamaged.
e. Look up tailpipe to check condition of turbine blades and check shroud to see that there is no evidence of turbine blades rubbing.
f. Auxiliary air intake doors uncovered.

## 7 LEFT WING

a. Reverse procedure given for right wing.
b. Wing trimmer hinge points secured and safetied with cotter pin.
c. Play in trimmer not to exceed 1/8 inch.

## 8 FUSELAGE - LEFT SIDE

a. Inboard flaps and speed brakes hinge points secured and safetied and contour flush with fuselage and wing stub.
b. Speed brakes full up.
c. Overall view of main landing gear indicates no obvious defects.
d. Main gear tire and shock strut properly inflated.
e. Intake duct unplugged.
f. Access doors closed.
g. Fuselage fuel tanks filler caps and doors secure.

*Figure 2-1. Exterior Inspection Diagram*

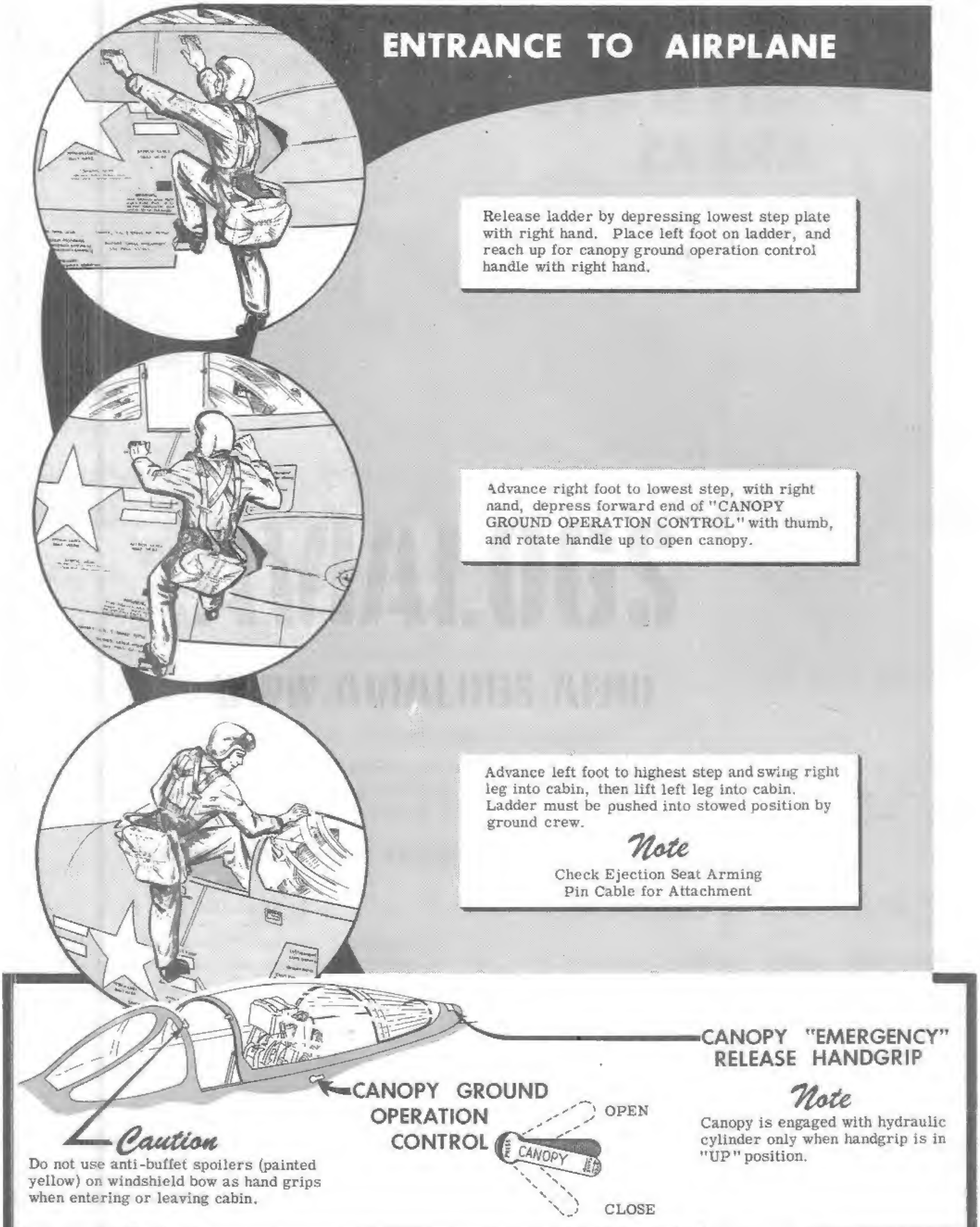



*Figure 2-2. Entrance to Airplane*


*Figure 2-3. Danger Areas*

q. Fire warning lights (test lights and system).

r. Check operation of auxiliary hydraulic pump—1700 psi normal.

**CAUTION**

Do not operate pump any longer than necessary.

**INTERIOR CHECK—NIGHT FLIGHTS.**

a. Set instrument panel lights and console lights switches to BRIGHT.

b. Set individual exterior lights switches to BRIGHT set auxiliary exterior lights master switch to ON, and set exterior lights master switch to its MAN, CODE, FLASH and STDY positions, pausing at each position to check operation of the exterior lights. (See Exterior Lighting System paragraph, Section IV for description and operation of exterior lights.) Set individual exterior lights switches to DIM and repeat check.

c. Dim all warning lights as desired.

d. If desired, remove antiglare shield from map case and install at top of instrument panel using fasteners on windshield deck and cabin rails. Place support pocket over gunsight pad and tension string on forward side of target span scale on sight unit.

## BEFORE STARTING ENGINE.

**CAUTION**

If feasible, have airplane turned into the wind. Check that personnel are clear of the tailpipe and intakes (see figure 2-3), and that external power is plugged in.

a. Wing trimmer at zero.

b. Adjust stabilizer—2.5° airplane nose-up trim.

c. Rudder trimmer at zero.

d. Set oxygen regulator as desired.

e. Hydraulic pressure control lever—HYDRAULIC PRESSURE ON.

f. Fuel quantity. Check push-to-test and low fuel level warning light.

g. Check that reference pointer on tailpipe temperature indicator is set at 800°C.

h. Check that flaperette emergency system air pressure gage indicates 1900-2000 psi.

## STARTING ENGINE.

**CAUTION**

Use only the following procedure to start the engine. Any divergence might result in a hot start, a condition which is is seriously detrimental to the engine and which will abnormally shorten its life. See Hot Starts paragraph for precautions to be observed.

**Note**

Tachometer indicator shows per cent of rated rpm 100% = 11000 rpm.

a. Check that throttle is at CLOSED.

b. Check that battery switch is at BAT. & GEN.

c. Set fuel master switch to ON—after a few seconds, check that fuel boost pressure warning light goes out, indicating that sufficient fuel pressure (6 psi minimum) has been built up.

**Note**

This is not a positive check of the boost pump. A malfunctioning pump may build up 6 psi fuel pressure with a closed fuel system and still not provide sufficient pressure under flow conditions.

d. Set engine start master switch to ON.

e. Set engine fuel system selector switch to RESET PRIMARY and hold for two seconds, then set to START & PRIMARY.

f. Set cranking switch to START momentarily and release.

g. As soon as engine commences to crank, move throttle outboard to START.

h. Hold throttle in START detent until tachometer indicates 5-6% rpm.

i. At 5-6% rpm, move throttle to IDLE detent, being careful not to advance past IDLE.

j. Allow engine to accelerate to idle.

**Note**

If trouble is encountered while attempting to start on START & PRIMARY, set fuel system selector switch to EMER. and attempt an engine start as outlined. After a successful start is accomplished on EMER., allow engine to stabilize for 30 seconds at IDLE and perform steps n., l., p., k. (excepting 30 second engine stabilizing period), q. and r. in order listed.

**WARNING**

If engine was started with engine fuel system selector switch set at EMER., make sure engine performance is checked with this switch set at START & PRIMARY.

**CAUTION**

If tailpipe temperature exceeds 750°C, a hot start has occured; IMMEDIATELY close throttle. Cause of hot start should be ascertained and the possible resultant damage should be surveyed before restart is attempted.


**Note**

Maximum tailpipe idling temperature is 565°C. However, during engine acceleration from start to idling rpm, the temperature may exceed this maximum somewhat but will return to normal as engine operation stabilizes.

k. After allowing engine to stabilize for 30 seconds at IDLE, 33-35% rpm, advance throttle to full OPEN and check tachometer. It should indicate 100% rpm.

l. Retard throttle to 55-60% rpm.

m. Set engine fuel system selector switch to EMER. —amber light will glow.

n. Advance throttle slowly to full OPEN (100% rpm normal, 101.5% rpm maximum).

**Note**

With engine fuel system selector switch at EMER., engine rpm may not reach 100% on cold days.

o. Retard throttle to 55-60% rpm.

p. Set engine fuel system selector switch momentarily to RESET PRIMARY, then to START & PRIMARY—amber light will go out.

q. Retard throttle to IDLE, 33-35% rpm.

r. Check operation of engine fuel boost pump. If fuel pressure warning light glows after fuel boost pump cut-off switch is actuated, pump is not operating. If light glows, shut down and investigate.

### FALSE STARTS.

If light-up does not occur within 15 seconds after advancing throttle to IDLE, or if engine fails to accelerate to idle rpm within approximately one minute after light-up, proceed as follows:

a. Set throttle to CLOSED.

b. Set engine start master switch to OFF.

c. When engine stops rotating, set fuel master switch to OFF and investigate.

**CAUTION**

Never set fuel master switch to OFF until engine stops rotating.

#### CLEARING ENGINE.

a. Set engine start master switch to ON, and fuel master switch to ON.

b. Set cranking switch to START and release.

c. Operate engine at 8-10% rpm for 30 seconds to clear engine.

d. Set engine start master switch to OFF to discontinue clearing procedure.

**CAUTION**

Do not set cranking switch to START until engine has stopped rotating.

**WARNING**

If the throttle is closed inadvertently during engine operation, there will be an immediate flame-out which will be impossible to catch, regardless of how quickly the throttle is reopened. DO NOT TRY TO REGAIN IGNITION BY REOPENING THE THROTTLE, since raw fuel will be sprayed out of the tailpipe and create a dangerous condition. A standard start or relight procedure will be necessary to restart the engine.

#### HOT STARTS.

A hot start is a condition occurring during a starting attempt wherein the tailpipe temperature soars above normal and flaming or torching occurs at the tailpipe exit. It may be caused by a malfunctioning of the fuel metering system or by a faulty starting procedure, but it is the direct result of one condition— an excess of fuel in the combustion chambers. Use only the approved starting procedure for starting the engine. When a hot start occurs, observe the following procedure:

a. Set throttle to CLOSED.

b. When engine has stopped rotating, set fuel master switch to OFF.

c. Clear engine, using procedure given in Clearing Engine paragraph.

d. After investigation, if it has been determined that the hot start was caused by other than a system malfunction, attempt a restart.

**Note**

For procedure to be followed in case of fire, see Fire paragraph, Section III.

#### RUNAWAY STARTS.

A runaway start is a rare occurence, but can be encountered if the fuel control malfunctions, or if a section of the throttle linkage is disconnected. In such a case, the engine must be stopped by cutting off the fuel supply from the tanks to the engine. This is done by setting the fuel master switch to OFF (battery switch must be set at BAT., or BAT. & GEN.).

## ENGINE GROUND OPERATION.

#### WARM-UP.

a. Allow engine to run at idling speed (33-35% rpm) for approximately 30 seconds, as a normal stabilizing period.

b. With throttle set at IDLE, check the following instruments:

Tachometer—33-35% rpm.
Tailpipe temperature indicator—565°C maximum.
Oil pressure—10 psi minimum, 15-35 psi normal.

**Note**

Prolonged idling at low rpm may result in excessive tailpipe temperature. If this occurs, operate at 55-65% rpm for a short time. This rpm gives the coolest ground operating temperature. At periodic engine check time (after overhaul, etc), or if engine malfunctioning is suspected, an acceleration check may be made as follows: open throttle abruptly and during acceleration to 100% rpm note tailpipe temperature—it should not exceed 800°C (acceleration limit). Time to accelerate from idle to 100% rpm should be 9-14 seconds.

## GROUND TESTS.

#### HYDRAULIC SYSTEM.

a. Check that hydraulic pressure gage indicates 1400-1500 psi.

b. Spread and lock wings (check indicators).

c. Check flaps operation.

d. Check flaperon operation.

e. Check speed brakes operation.

#### FLAPERETTE OPERATIONAL CHECK.

With engine running, set flaperette system switch to EMER. & TEST position. Check that flaperettes deflect up in response to control stick movement. Return switch to AUTO. position after check.

#### LONGITUDINAL CONTROL SYSTEM CHECK.[1]

a. Raise flaps.

b. Pull longitudinal control system selector control knob up (hydraulic).

c. Check that stabilizer electrical trim selector switch is at NORM.

[1]Airplanes ser No. 131063 through 131067, 131071, 131075 and subsequent.

d. Trim stabilizer full airplane nose-down (1-3/4 degrees), using stick grip trim switch (neutral stick, zero stick force).

e. Trim stabilizer 0 degrees, using stick grip trim switch (neutral stick, zero stick force).

f. Move stick fore and aft full throw and check stabilizer motion in mirror and on absolute stabilizer position indicator on instrument panel.

**Note**

The stabilizer travel limits will be 4-1/2 degrees airplane nose-down for full forward stick and 6-1/2 degrees airplane nose-up for full aft stick with 0 degrees stabilizer trim setting.

g. Retrim stabilizer to the airplane full nose-up trim position (6 degrees) (neutral stick, zero stick force).

h. Move stick fore and aft full throw and check stabilizer motion in mirror and on absolute stabilizer position indicator.

**Note**

The stabilizer travel limits will be about 1-1/2 degrees airplane nose-up for full forward stick and 6-1/2 degrees airplane nose-up for full aft stick with 6 degrees airplane nose-up trim.

i. Holding neutral stick, lower flaps and check for shift of longitudinal control to manual.

j. Retrim stabilizer 0 degrees using stick grip trim switch (neutral stick, zero stick force).

k. Set stabilizer electrical trim selector switch to EMERG. and, using emergency trim switch (neutral stick, zero stick force) run stabilizer to air-plane full nose-up trim position (6 degrees), then to airplane full nose-down trim position (1-3/4 degrees) and back to 0 degrees.

l. Reset stabilizer electrical trim selector switch to NORM., retaining the 0 degrees airplane nose-up trim setting.

m. Push longitudinal control system selector control knob down (manual).

n. Check operation of elevators for full throw.

o. Lower flaps.

p. Retrim stabilizer for take-off (2-1/2 degrees airplane nose-up, or as desired).

**LONGITUDINAL CONTROL SYSTEM CHECK.**[1]

a. Raise flaps.

b. Set longitudinal control system selector switch to HYDRAULIC.

c. Check that emergency manual control knob is in up (normal) position.

d. Check that stabilizer electrical trim selector switch is at NORM.

e. Trim stabilizer full airplane nose-down (1-3/4 degrees), using stick grip trim switch (neutral stick, zero stick force).

f. Trim stabilizer 0 degrees using stick grip trim switch (neutral stick, zero stick force).

g. Move stick fore and aft full throw and check stabilizer motion in mirror and on absolute stabilizer position indicator on instrument panel.

**Note**

The stabilizer travel limits will be 4-1/2 degrees airplane nose-down for full forward stick and 6-1/2 degrees airplane nose-up for full aft stick with 0 degrees stabilizer trim setting.

h. Retrim stabilizer to the airplane full nose-up trim position (2-1/2 degrees) (neutral stick, zero stick force).

i. Set stabilizer electrical trim selector switch to EMERG. and, using emergency trim switch, run the stabilizer to the airplane full nose-up trim position (6 degrees) (neutral stick, zero stick force).

j. Move stick fore and aft full throw and check stabilizer motion in mirror and on absolute stabilizer position indicator.

**Note**

The stabilizer travel limits will be about 1-1/2 degrees airplane nose-up for full forward stick and 6-1/2 degrees airplane nose-up for full aft stick with 6 degrees airplane nose-up trim.

k. Holding neutral stick, lower flaps and check for shift of longitudinal control to manual.

l. Reset stabilizer electrical trim selector switch to NORM., retaining the 6 degrees airplane nose-up trim setting.

m. Raise flaps and note that stabilizer automatically returns to 2-1/2 degrees airplane nose-up.

n. Set longitudinal control system selector switch to MANUAL.

o. Check operation of elevators for full throw.

p. Lower flaps.

q. Retrim stabilizer for take-off (2-1/2 degrees airplane nose-up, or as desired).

**ELECTRICAL SYSTEM.**

GENERATOR CHECK.

With engine idling and external power disconnected, advance throttle and check voltmeter and generator warning light. Voltmeter should indicate 27.5-28.0 volts and generator warning light should remain out.

LIGHTS.

Check operation of the following lights:

a. All press-to-test lights.

b. Fire warning lights. Check circuit continuity with test switch.

RADIO CHECK.

Check communication and navigational equipment.

[1]Airplanes ser No. 131068 through 131070 and 131072 through 131074.

FLIGHT INSTRUMENTS.

Set and align G-2 compass so that operation may be checked while taxiing. Erect attitude gyro.

YAW DAMPER CHECK.

The yaw damper system can best be checked while taxiing. Slow turns will give a rudder reaction opposing the turn.

## TAXIING.

The general taxiing characteristics of this airplane are similar to the conventional straight wing, tricycle gear airplane. The "stick upwind" technique normally employed in slow speed cross-wind taxiing is not beneficial on this airplane because of its flaperon lateral control system. Approximately 50% thrust is necessary to overcome starting friction, but a setting slightly above idle is sufficient to maintain taxi speed. The nose wheel is self-centering and is not steerable. Use the brakes to steer the airplane. To stop, retard throttle and apply brakes evenly. Restrict taxi time to an absolute minimum as fuel consumption during ground operation is exceedingly high. Fuel flow while taxiing is approximately 20-25 pounds per minute. Each minute of taxiing time reduces range by five miles.

## BEFORE TAKE-OFF.

### PREFLIGHT AIRCRAFT CHECK.

a. Controls unlocked and surfaces move freely.

b. Attitude and directional gyros set as desired. Check operation.

c. Longitudinal control system selector control pushed down or switch set to MANUAL.

d. Stabilizer electrical trim selector switch set to NORM.

e. Speed brakes UP.

f. Yaw damper ON.

g. Cabin air conditioning system on-off switch ON (TEMP) and regulate system for desired temperature by means of the increase-decrease switch.

**Note**

On humid days, set air conditioning system to OFF (RAM AIR) and regulate system for desired amount of ram air by means of the increase-decrease switch. Climb to 5000 feet before turning off ram air. This will prevent fog formation in the cabin.

h. Set cabin air vent controls as desired.

**Note**

The following items (steps i. through t., are those of the take-off check list.

i. Check flying tail.

j. Hydraulic pressure control lever—HYDRAULIC PRESSURE ON.

k. Wings locked.

l. Flaperette switch—AUTO.

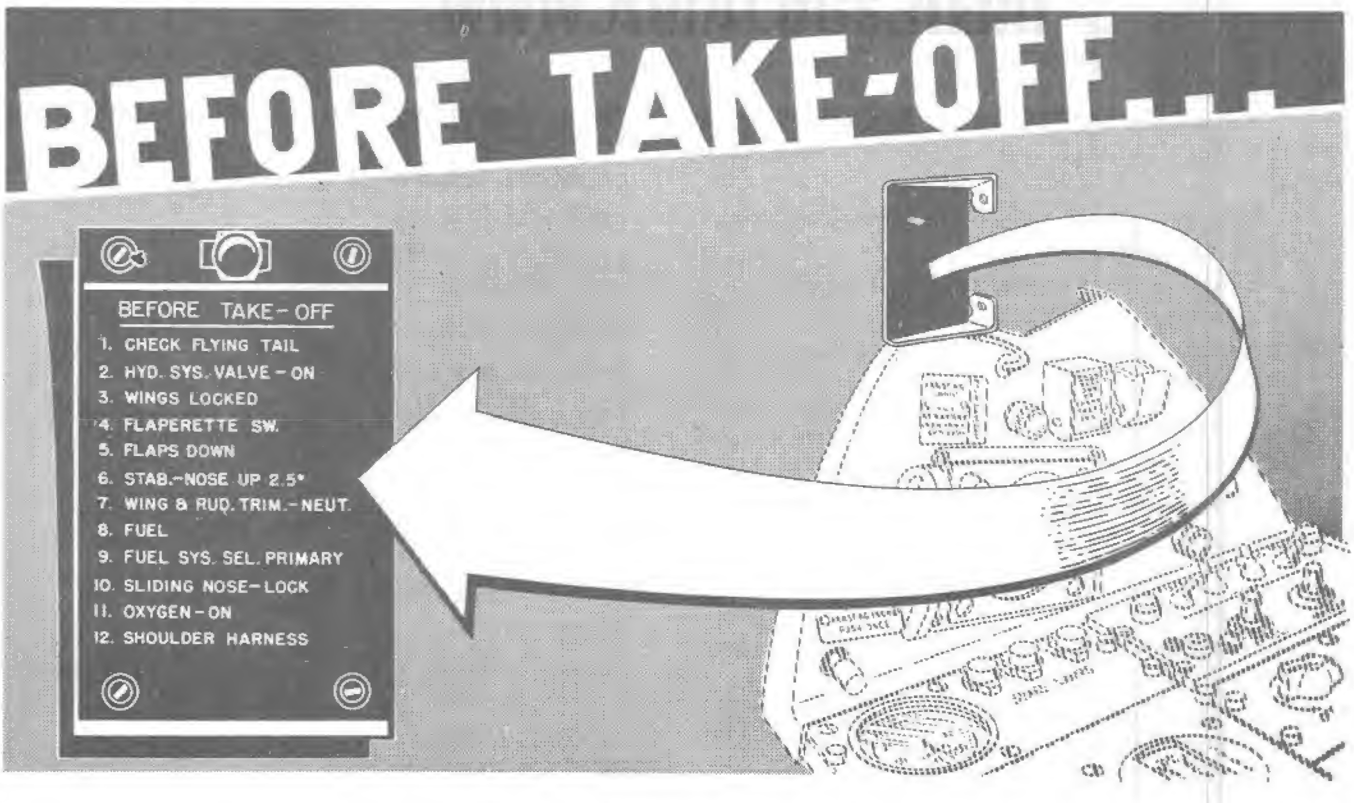



*Figure 2-4. Take-off Check List*

m. Flaps down.

n. Stabilizer—airplane nose-up 2.5°.

**WARNING**

With the longitudinal control system selector control knob[1] pushed down, set stabilizer trim. When operating with this knob pulled up, the absolute stabilizer position indicator denotes trim position only when the control stick is in neutral and no fore or aft stick force is being applied.

**WARNING**

With the longitudinal control system selector switch[2] at MANUAL, set stabilizer trim. When operating with this switch set at HYDRAULIC, the absolute stabilizer position indicator denotes trim position only when the control stick is in neutral and no fore or aft stick force is being applied.

o. Wing and rudder trim—neutral.

p. Fuel.

q. Fuel system selector switch—START & PRIMARY.

r. Sliding nose—locked.

s. Oxygen—ON.

t. Shoulder harness (tight and locked).

u. Seat positioned as desired.

v. Canopy (open).

w. Taxi out into take-off position, heading airplane straight down runway with nose wheel straight.

**PREFLIGHT ENGINE CHECK.**

With engine operating normally and brakes on, advance throttle to 100% rpm and check instruments.

a. Oil pressure—20 psi minimum, 35-45 psi normal.

b. Tailpipe temperature—780°C maximum.

**Note**

Check that amber emergency fuel system warning light is out.

**CAUTION**

Do not hold 100% rpm more than one minute.

## TAKE-OFF.

a. Take-off check list completed.

b. Hold brakes and advance throttle.

c. With engine at take-off rpm, release brakes and begin take-off run.

d. Maintain direction with brakes and flaperons until rudder control becomes effective (60-70 knots). A raised flaperon adds drag to assist brakes.

e. For normal take-off, raise nose slightly at 110-120 knots (full internal fuel, no stores) and fly the airplane off at 125 knots. This will result in a ground run approximately 130% of the minimum distances given on the Take-off Distance Curves in Appendix I. For minimum ground run, raise nose 5-10 knots below lift-off CAS given on these curves.

**Note**

A very high angle of attack at too low a speed will increase drag and lengthen take-off run.

f. Landing gear up when definitely airborne (retraction time about 10 sec).

g. Close canopy.

h. Flaps up above 150 knots IAS.

i. Accelerate to best climbing speed (390 knots approximately); see Climb Curves in Appendix I.

j. When at a safe altitude, shift longitudinal control system to hydraulic power (5000 feet recommended).

**Note**

There may be a small trim change when shifting from one system to the other. This is at a minimum at speeds of 250 to 350 knots. For familiarization flights, it is recommended that the shift be made within this speed range.

k. The take-off distances to clear a 50 foot obstacle are given in Takeoff Distance to Clear 50 Foot Obstacle Curves in Appendix I. Immediately after lift-off, level off and accelerate to speeds (shown on the above curves) to clear 50 foot obstacle. Do not exceed these speeds as they result in an optimum climb angle. Gear should be retracted as soon as airborne. After clearing obstacle, retract flaps above 150 knots IAS and accelerate to best climb speed.

l. Emergencies—see Section III.

## CLIMB.

Climb at take-off rpm or the rpm for tailpipe temperature limits. (See Section V, figure 5-2 for engine operating limits.)

See Climb Curves in Appendix I for recommended climb airspeeds and other pertinent climb data. After reaching a safe altitude, pull longitudinal control system selector control up[1], or set longitudinal control system selector switch to HYDRAULIC.[2]

## FLIGHT CHARACTERISTICS. See Section VI.

## SYSTEMS OPERATION. See Section VII.

## DESCENT.

Utilize speed brakes to decelerate. Use of idle rpm (throttle at IDLE setting) during descent will conserve fuel.

[1]Airplanes ser No. 131063 through 131067, 131071, 131075 and subsequent.

[2]Airplanes ser No. 131068 through 131070 and 131072 through 131074.

# LANDING PATTERN

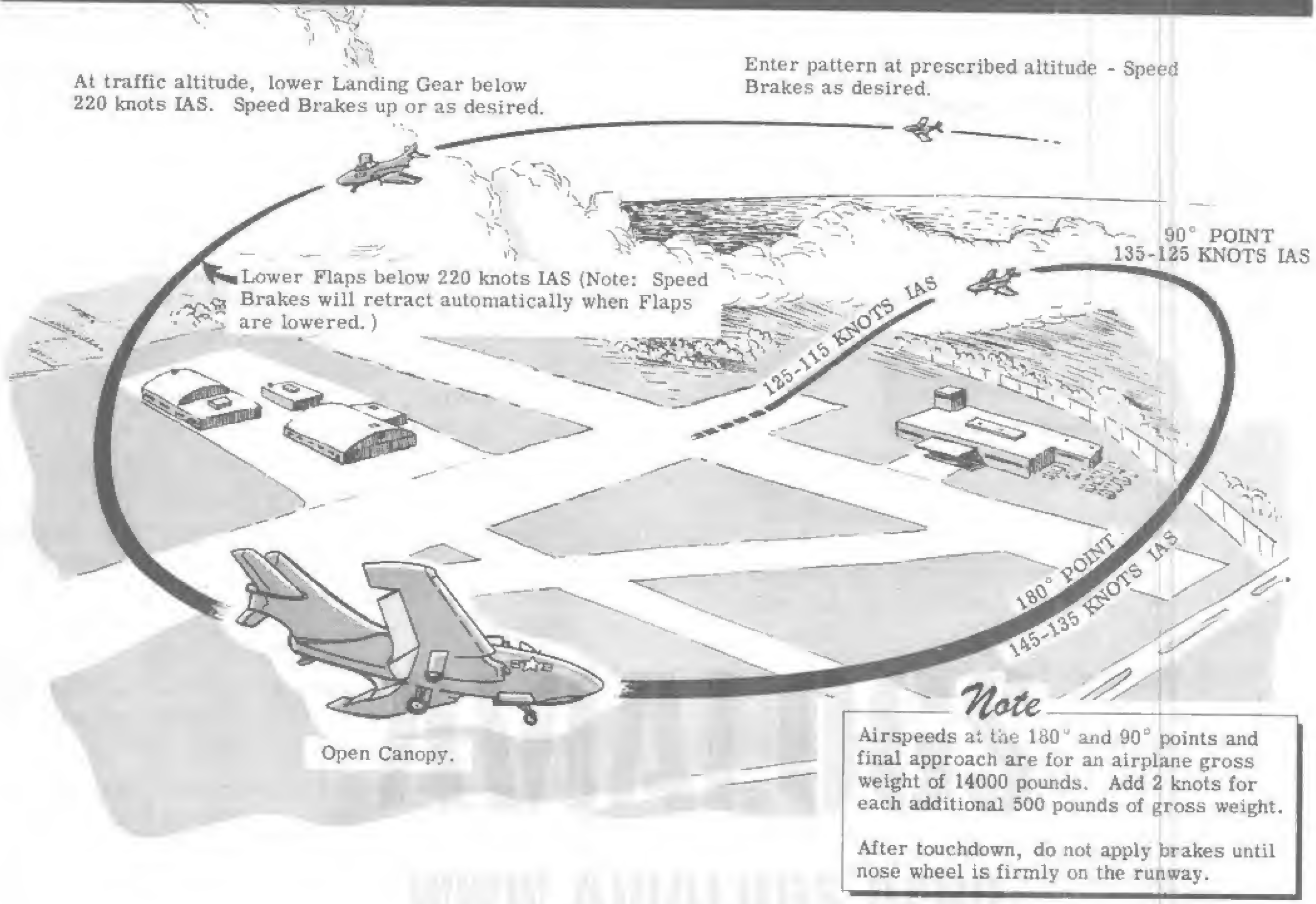



*Figure 2-5. Landing Pattern Diagram*

**Note**

Due to engine compressor blade resonant vibration peak, it is recommended that the rpm range of 68-76% be used as little as possible.

Two standardized descent schedules are given in Appendix I in figures A-8 and A-9. Descents with the low fuel level warning light on must be made in accordance with the procedure given in Appendix I, Description of Charts and Tables paragraph, step g.

## PRE-TRAFFIC PATTERN CHECK LIST.

a. Armament master switch—OFF; gun switches—SAFE.

b. Hydraulic pressure control lever—HYDRAULIC PRESSURE ON.

c. Wing tanks—empty.

d. Check communication equipment.

e. Yaw Damper—ON.

f. Change to manual longitudinal control (push longitudinal control system selector control down or set longitudinal control system selector switch to MANUAL). For familiarization flights, 5000 feet altitude is recommended.

g. Set wing tanks dump switch to NORMAL.

## TRAFFIC PATTERN CHECK LIST.

a. Lower landing gear when below 220 knots.

b. Arresting hook—extend for carrier landing.

c. Flaps down when below 220 knots.

**Note**

If speed brakes have been used to decelerate, they will retract automatically before the flaps will extend.

d. Depress brake pedals—check "feel".

e. Check fuel quantity.

f. Shoulder harness and seat belt—locked and tightened.

g. Canopy—open.

## LANDING.

For field landings, make final approach at 120 to 130% of power-off stall speed with wheels and flaps extended. See figure 6-1, Stall Speeds Chart. Avoid high rates of descent on final approach, as airplane's response to landing flare-out is slower than that of a straight wing

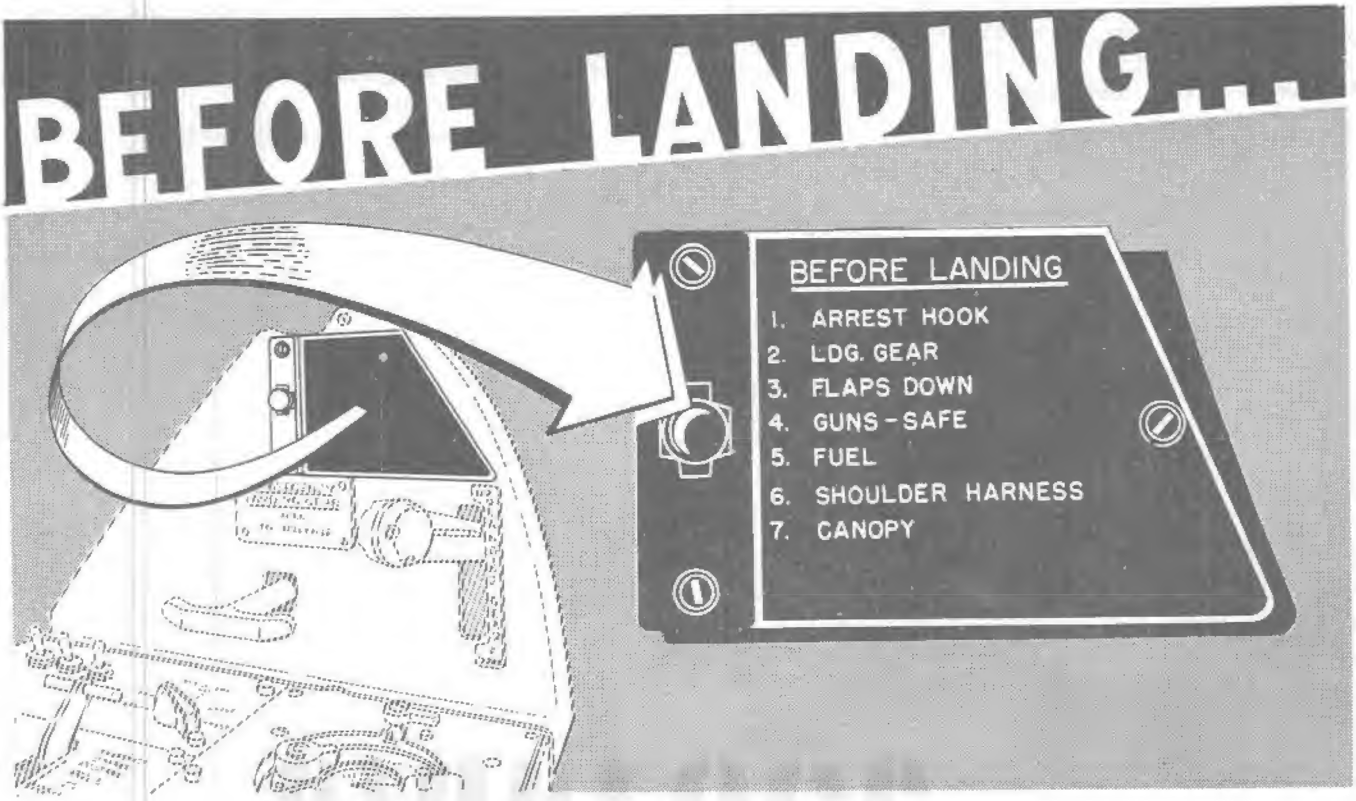



*Figure 2-6. Landing Check List*

airplane. For landing pattern diagram, see figure 2-5; for emergency procedure, see Section III.

**CAUTION**

Because of the slower accelerating characteristics of the jet engine, landing traffic pattern should be made to permit engine operation above 65% rpm.

**Note**

Limit engine operation between 68-76% rpm to as short a time as possible.

Brakes should be applied after the nose wheel has contacted the runway. For extended tire life, use only as much braking as necessary.

**Note**

During initial roll-out, the flaps are particularly effective for decelerating if the nose of the airplane is held high.

### CROSS-WIND LANDING.

Cross-wind approach and touch-down techniques used for straight wing airplanes are applicable. Satisfactory control during roll-out can be obtained in cross-winds greater than 25 knots by using flaperons (for drag) to supplement rudder control after setting nose wheel on the runway.

## WAVE-OFF.

Remember that the jet engine will not respond as quickly as a reciprocating engine. Maintaining at least 65% rpm while in the landing pattern will assist in making a rapid wave-off.

a. Throttle—full forward.

b. Landing gear up—when climbing.

c. Flaps up—above 150 knots.

**Note**

Approximately 220 pounds of fuel will be required to go around again in a tight pattern.

## AFTER LANDING.

a. At end of taxi run, raise flaps.

b. If tailpipe temperature is high from hard taxiing or stationary ground running, operate at 55-65% rpm for one minute.

**CAUTION**

After wings are folded, it is recommended that wing fold jury struts be installed before the engine is shut down.

### STOPPING ENGINE.

a. Retard throttle to CLOSED from a stabilized rpm.

**Note**

Check that engine runs down freely. Engine driven accessories will slow down the engine. Any undue friction should be noticeable.

b. After engine stops rotating, set fuel master switch to OFF.

c. After 10 seconds, set engine start master and battery switches to OFF.

**BEFORE LEAVING AIRPLANE.**

a. Set all switches to off.

b. Install surface controls lock (bridle) and make up seat belt over front of stick.

c. Close canopy, using handle on left side of fuselage, after leaving the cabin.

d. Be sure airplane is properly chocked.


## ENGINE FAILURE.

### ENGINE FAILURE DURING TAKE-OFF.

a. If power fails before leaving ground, retard throttle to CLOSED and use brakes.

b. If power fails after becoming airborne, but while there is still runway left, retard throttle to CLOSED, land, and use brakes. For minimum stopping distance, fly the airplane onto the ground, force the nose wheel on the ground with full forward stick, and begin using brakes. Apply the brakes gently at first, increasing pedal pressure as they take effect. Be careful in applying brakes to avoid blowing a tire, because braking effectiveness with blown tires is poor. For this same reason, the emergency air brake should not be used until speed is below at least 50 knots, since the air brake will blow both main tires if applied at too high a speed.

c. If power fails after becoming airborne, and there is no runway left, retard throttle to CLOSED, move landing gear control lever to UP, move wing flap lever to DOWN, and land straight ahead.

d. If the failure occurs above several hundred feet, push over, hold 160 knots, and follow procedure in step c., above. If time permits, an abbreviated emergency engine relight procedure may be tried as follows:

Fuel system selector switch to EMER.

Throttle to IDLE.

Pull emergency igniter system control handle.

Open throttle as engine rpm increases through idle.

(See Airstart paragraph, this section, for complete procedure.)

### ENGINE FAILURE IN FLIGHT.

**Note**

The information and procedures presented in this section are based on actual flight tests.

GENERAL.

Although sudden failure of the engine in flight may be an alarming surprise to the pilot, the situation probably will not be critical immediately. There will be no change in the controllability of the airplane. If the engine has flamed out because of trouble in the primary fuel control, the chances of obtaining a relight in the emergency fuel control are excellent. If the engine failure is more serious and it cannot be restarted, a controlled let-down and satisfactory dead engine landing or ditching can probably be made without unusual difficulty. Immediately after an engine failure, the following conditions will be apparent to the pilot:

a. Loss of thrust, rapid dropping of engine rpm and tailpipe temperature.

b. Failure of the cabin pressurization system. The noise level in the cabin will become quieter and cabin altitude will increase to the airplane altitude.

c. Failure of the electrical circuits on the main bus of the electrical system as engine windmill rpm drops below generator cut-in speed (provided battery switch is in BAT. & GEN. position).

A procedure of steps to be taken after an engine failure is included in this section; however, the following general information should be kept in mind:

a. For maximum gliding range, the airplane should be as clean and light as possible.

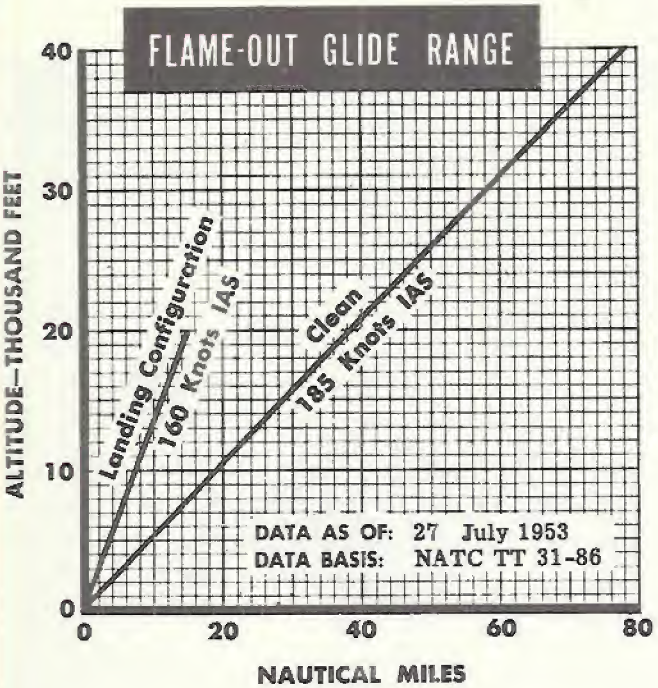



*Figure 3-1. Flame-out Glide Range Curves*

b. For maximum range in the clean configuration, maintain 185 knots IAS. As indicated airspeed 10 knots higher or lower than 185 knots reduces gliding distance only two per cent, so strict adherence to this airspeed is not necessary. Pilots gliding into strong head winds will get some increase in glide distance by increasing their glide speed 5 knots for each 15 knots of head wind.

The best approach speed in the landing configuration is 160 knots IAS. The use of any approach speed less than this will very likely result in a hard landing due to insufficient airspeed for flaring out.

The gliding distance in the clean and landing configuration is shown in figure 3-1. The rate of descent at various altitudes is shown in figure 3-2.

**Note**

Data given on figures 3-1, 3-2 and 3-3 are based on F9F-6 flight tests and are estimated to be valid for the F9F-8 airplane.

c. The windmilling engine will provide 1500 pounds of hydraulic pressure and sufficient capacity to operate the flying tail, flaperons, speed brakes, landing gear and flaps. Times required to extend the landing gear and wing flaps are shown in Table III-I.

The landing gear and flaps may be lowered faster by using the auxiliary hydraulic pump. The gear and flaps both take about 50 per cent longer to operate by the auxiliary hydraulic pump with engine dead than by the engine driven hydraulic pump with engine operating.

**TABLE III-I**

**TIMES REQUIRED FOR LANDING GEAR AND WING FLAP EXTENSION WITH AUXILIARY HYDRAULIC PUMP OFF— ENGINE WINDMILLING**

| | | | |
|---|---|---|---|
| Landing Gear (185 knots, 10000—12000 ft) | 10-12 sec | Wing Flaps (160 knots, 8500 ft) | 30 sec |

**Note**

At higher altitudes, landing gear and wing flaps extend at faster rates because of increased engine windmill speed at same IAS.

The landing gear may be extended by using the emergency air bottle. Extension time is five to six seconds. To conserve the battery, it is preferable to lower the landing gear by the emergency bottle rather than by the auxiliary hydraulic pump. However, if landing gear is extended by use of air bottle, it cannot be retracted.

d. Lateral control is satisfactory in an engine windmilling descent and landing for all airplane configurations. The windmilling engine will maintain adequate hydraulic pressure for normal flaperon control until the airspeed drops below 70 knots after touchdown. Automatic switchover to flaperette control will occur instantly when hydraulic pressure drops below that necessary for flaperon control.

e. With the engine windmilling at less than generator cut-in speed, all electrical circuits except those connected to the essential bus are automatically disconnected when the battery switch is in the BAT. & GEN. position and the landing gear control handle is UP. (For circuits connected to the essential bus, see

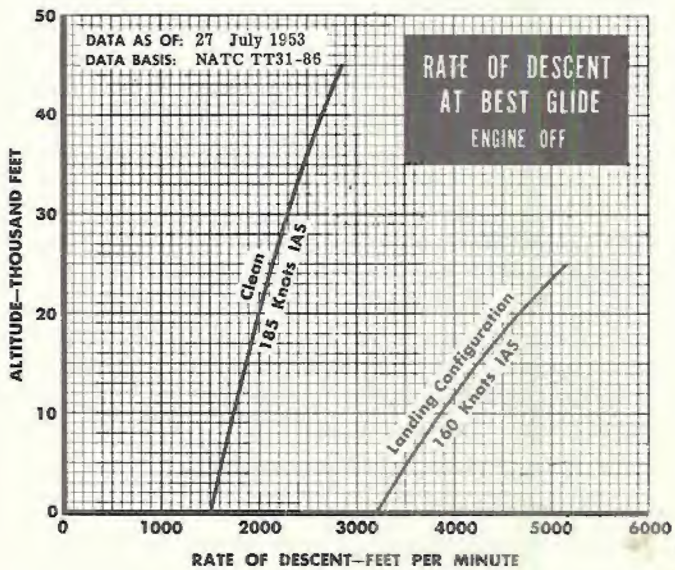



*Figure 3-2. Rate of Descent at Best Glide Curves*

figure 1-9.) If it is desired to operate a circuit on the main bus, such as the radio, auxiliary hydraulic pump, or exterior lights, the battery switch may be placed in the BAT. position. Placing the landing gear control handle in the DOWN position also energizes the main bus. With the battery switch in BAT., a perfect battery will last approximately 13 minutes. If the battery is conserved by pulling the circuit breakers of unnecessary systems, it will last approximately 25 minutes. If an airstart is to be attempted, it is best to use as little electrical power as possible to insure that the battery power will be sufficient for the airstart. If an airstart is to be attempted, never set the battery switch to OFF as this cuts off the electrical fuel boost pump.

f. Canopy frosting may occur during engine-off descents. It will be the most severe when descending from high altitudes into an atmosphere of high humidity. The frosting can be kept to a minimum by opening the canopy slightly.

PROCEDURE.

The following procedure applies to the situation where the landing gear, wing flaps, and speed brakes are up when the engine fails and the airplane has at least several thousand feet of altitude over the terrain.

a. Retard throttle to CLOSED.

b. Establish 185 knots IAS as soon as possible for maximum range glide. If speed is above 185 knots, pull up and climb until speed drops to 185 knots.

c. If at high altitude, check oxygen mask for tight fit after pressure surge following loss of cabin pressurization.

d. Dump wing tank fuel and jettison external stores, if carried.

**Note**

Under certain conditions, attempt a relight before dumping wing tank fuel in order not to jeopardize chances for a safe return to base if relight attempts are successful.

e. Check that battery switch is in BAT. & GEN. position to conserve battery. If power is desired for communications or for auxiliary hydraulic pump, set switch to BAT. and pull out circuit breakers to deenergize unnecessary equipment.

f. Initiate airstart procedures when below 25000 feet, using normal relighting procedure. If normal relight procedures are unsuccessful, use emergency igniter relight procedure when below 18000 feet. If altitude is low and time limited, use emergency igniter relight procedure first. (See Airstart paragraph, this section, for relight procedures.)

g. If all attempts to relight are unsuccessful and the situation occurs at night, during bad weather, or over mountainous terrain, eject from the airplane. (See Bail-Out paragraph, this section, for ejection procedure.)

h. If an airstart has not been achieved after repeated attempts, or by the time 10000 feet is reached, and the situation occurs during daylight hours under favorable conditions, all efforts should be turned toward making a successful landing.

i. If engine failure occurs below 10000 feet, primary emphasis should be on making a successful landing. Do not jeopardize chances of making a successful landing by overconcentration on relight attempts.

## EMERGENCY LANDINGS.

### FORCED LANDING—DEAD ENGINE.

PATTERN.

The recommended pattern for dead engine landings and simulated flame-out landings is shown in figure 3-3. The patern consists of a 360 degree approach with two fixed check points. The initial point is defined as a position above and slightly to starboard of the intended landing point, with the airplane headed in the direction of the landing runway. The 180 degree point is the downwind position abeam of the intended landing point from which the turn onto base leg is made. Two possible patterns are presented because it is possible to make the approach with landing gear and flaps down all the way from the initial point, or to lower only the gear at the initial point and lower the flaps when needed later in the approach. If sufficient altitude is available, it is better to lower the flaps at, or before, the initial point, so that the flaps will extend fully and rate of descent will stabilize early in the aproach. A constant rate of descent will make it easier for the pilot to judge his gliding angle and plan his approach. However, if there is insufficient altitude to make this type of approach, it is possible to make the approach with the flaps up and extend them when needed to hit the desired landing point. This type of approach is not unduly difficult, but more judgement must be exercised by the pilot during the aproach. By following one of these patterns and using the pattern altitudes and airspeeds in figure 3-3, a pilot should be able to hit the desired landing point with relative ease. When using the recommended procedure for a dead engine landing, the pilot is required to exercise a minimum amount of judgement. This is beneficial in the event of a dead engine landing, because a pilot's judgement is likely to be impaired by the tenseness of the situation.

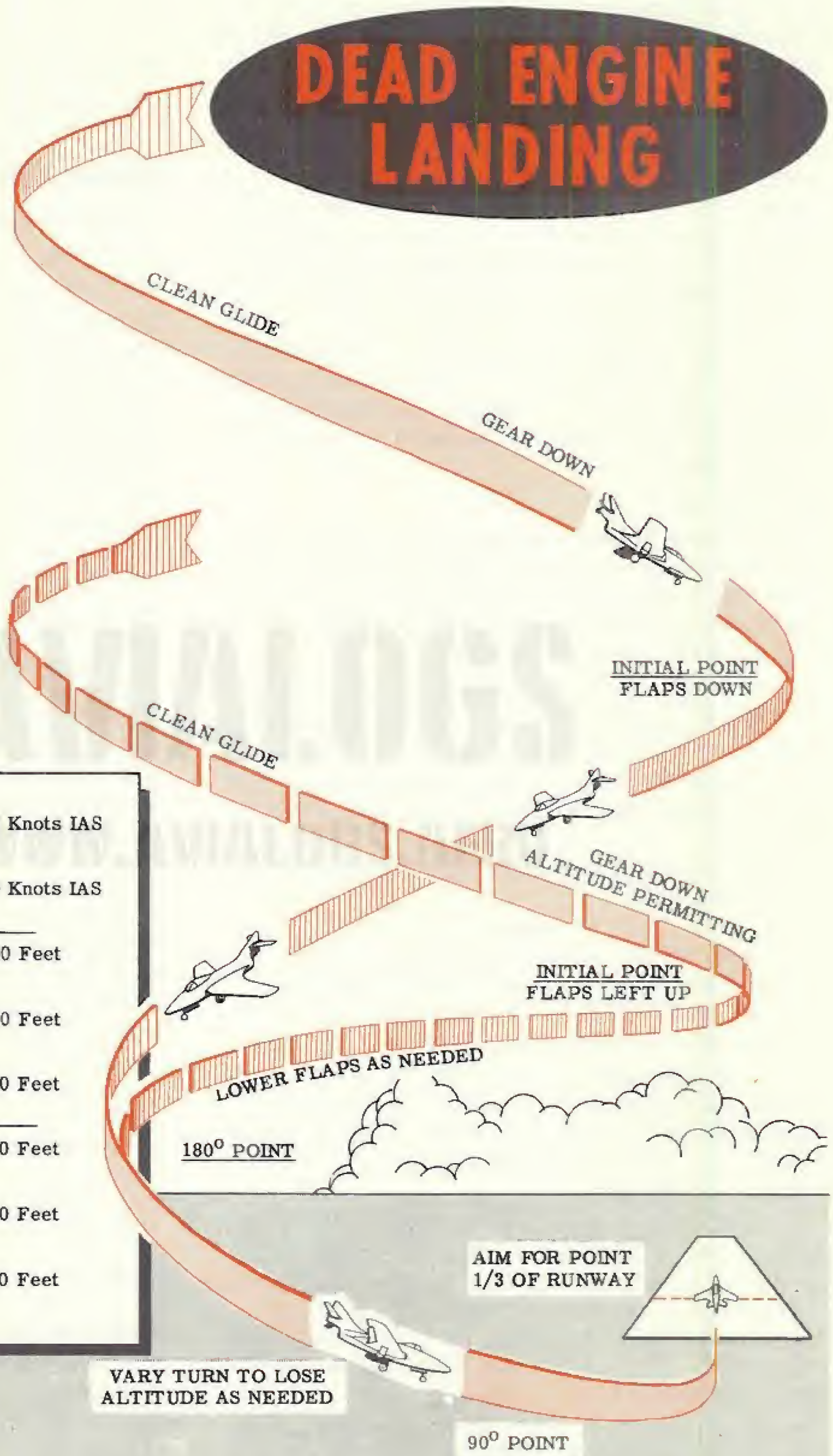
GENERAL PROCEDURE.

When a pilot is committed to a dead engine landing, either because of fuel exhaustion or failure to get an airstart after a flame-out, he should execute the following general procedure.

Establish the recommended clean gliding speed of 185 knots IAS and plan the letdown pattern so as to arrive over the initial point at the correct altitude for the type of approach to be made. The following steps should be started at sufficient altitude so as to be complete upon arriving over the initial point.

a. Retard throttle to CLOSED.

b. Set fuel master switch to OFF.




| | |
|---|---|
| Best Glide Speed<br>Clean Airplane | 185 Knots IAS |
| Recommended Approach Speed<br>Landing Condition | 160 Knots IAS |
| Optimum Altitude at Initial Point<br>Gear and Flaps Down | 8000 Feet |
| Optimum Altitude 180° Point<br>Gear and Flaps Down | 4500 Feet |
| Optimum Altitude 90° Point<br>Gear and Flaps Down | 2500 Feet |
| Optimum Altitude at Initial Point<br>Gear Down | 6000 Feet |
| Minimum Altitude at Initial Point<br>Gear Down | 5000 Feet |
| Minimum Altitude 180° Point<br>Gear Down | 2500 Feet |

DATA AS OF: 27 July 1953
DATA BASIS: NATC TT 31-86

*Figure 3-3. Flame-out Landing Pattern*

c. Set battery switch to BAT.

d. Push longitudinal control system selector control down[1] or move longitudinal control system selector switch to MANUAL[2].

e. Set auxiliary hydraulic pump to ON.

f. Move landing gear control lever to DOWN, if a safe landing is probable.

**Note**

If there is insufficient altitude to make the field with landing gear down, the landing gear should be left up and extended only when the field is definitely within reach. The landing gear may be extended quickest by using the emergency landing gear air bottle. The extension time will be five or six seconds. Once extended by use of the air bottle, the landing gear CANNOT be retracted.

g. Set speed brakes emergency landing override switch to its emergency position.

h. Lock and tighten shoulder harness. Remove personal connections (oxygen, "G" suit, radio leads).

i. Open canopy.

Extend flaps upon reaching the initial point, altitude permitting, and reduce speed to 160 knots IAS. Commence a left turn, banked 25 to 30 degrees. If the altitude over the initial point is higher than recommended, delay the turn slightly or decrease the bank so that the airplane will arrive at the 180 degree position at the correct altitude. If the initial point is reached with less altitude than the 8000 feet recommended for the high 360 degree patterns, continue the approach with flaps up, and lower the flaps as needed to reach the 180 degree position at the recommended 4500 foot, or to intercept the flaps-down landing path. When a crosswind prevails, shallow or steepen the turn from the initial point to the 180 degree position if the crosswind is from the port or starboard, respectively, in order to have the correct distance at the 180 degree position. At the 180 degree position, check the altitude, angle of descent and position to determine if the same turn may be continued, or if a shallower or steeper bank should be used. At the 90 degree position, the airplane should be approximately 5000 feet down-wind of the landing point, and the altitude should be approximately 2500 feet with the flaps down. Plan the final turn in order to reach the straightaway with about 1000 feet of altitude. If the airplane is high, nose over and pick up additional speed to steepen the glide path. The speed brakes may be opened to further steepen the glide path. It is also possible to use a forward slip to lose some altitude, but this should not be carried any lower than about 600 feet, because of the high rate of descent it will cause, and the resultant increased time and altitude required to flare out for landing. Normally, commence the flare-out at about 200 feet above the runway. In the event of a steeper glide path, brought about by the use of speed brakes, slips, or nosing over, commence the flare-out as high as 400 feet above the runway. When beginning the flare-out at altitudes above 200 feet, exercise care not to flare out too abruptly, causing the airplane to run out of airspeed at too high an altitude. If, at any time in the approach up to the last 500 feet of altitude, it is seen that the airplane is undershooting, maintain airspeed at 160 knots and retract the flaps partially or fully until the final approach, or until there is enough altitude so that they may again be lowered. If the airspeed is maintained, no noticeable sinking will result from retraction of the flaps and the glide range will be extended considerably. If there is still insufficient altitude to make the field with gear down, retract the landing gear and effect a wheels-up landing. THE MOST IMPORTANT SINGLE THING TO REMEMBER ABOUT THE DEAD ENGINE LANDING APPROACH IS THAT UNDER NO CIRCUMSTANCES SHOULD THE AIRSPEED FALL BELOW 160 KNOTS. Because of the higher than normal altitudes used on the flame-out landing, there is a strong illusion that the landing will be overshot. This is likely to cause the pilot to lengthen out his pattern and undershoot. For this reason, a point one-third the way down the runway should be the intended landing point. Make a normal landing and roll-out. If the airplane is high and fast over the end of the runway and it appears that insufficient runway remains for a normal landing and roll-out, fly the airplane onto the ground fast, force the nose wheel on the ground with full forward stick and begin using brakes. Apply the brakes gently at first, increasing pressure as they take effect. Be careful in applying brakes to avoid blowing a tire, because braking effectiveness with blown tires is poor. For this reason, the emergency air brake should not be used until speed is below at least 50 knots, since the air brake will blow both main tires if applied at too high a speed.

## SIMULATED DEAD ENGINE FORCED LANDINGS.

By practicing simulated dead engine forced landings, a pilot will develop sufficient skill and confidence in the maneuver so that an actual power-off landing will present no undue hazard.

To simulate a flame-out, the following rpm, with speed brakes extended, will result in the same rate of descent as for a dead engine, with brakes retracted.

| *Altitude* | *RPM* |
|---|---|
| 30000-20000 feet | 85% |
| 20000-10000 feet | 80% |
| Below 10000 feet, with landing gear and flaps down | 65% |

**Note**

To keep speed brakes extended when flaps are down, speed brakes emergency landing override switch must be set to emergency position.

[1]Airplanes ser No. 131063 through 131067, 131071, 131075 and subsequent.

[2]Airplanes ser No. 131068 through 131070 and 131072 through 131074.

When practicing simulated dead engine landings, the landing patterns of figure 3-3 should be followed. The pilot may vary his altitudes from those recommended in figure 3-3 to determine the easiest flame-out approach for him. In practicing simulated flame-out landings, the following precautions should be observed:

a. Normal field landing weight restrictions should be observed.

b. Before a pilot carries a simulated flame-out approach to a landing, he should make at least three approaches, taking a wave-off upon reaching an altitude of 500 feet.

c. Until pilots become thoroughly skilled in the maneuver, simulated flame-out landings should be made touch-and-go.

d. Simulated flame-out landings on runways shorter than 6000 feet should be performed with extra caution.

e. The 160 knots approach speed for flame-out and simulated flame-out landings should be regarded as a minimum.

f. Slips should not be carried any closer to the ground than 600 feet.

g. Care should be taken to commence the flare-out at sufficient altitude to insure a smooth landing.

h. When it appears that a hard landing is impending, the speed brakes should be retracted to prevent damage to the forward speed brake section.

After skill is once gained in the simulated flame-out landing, a pilot should refresh himself periodically to maintain a high level of proficiency in the maneuver. One or two simulated flame-out practices a month should be sufficient.

**IMPORTANT**

A simulated flame-out approach presents a good way to make an emergency landing when the reliability of the engine is questionable. Set up the standard simulated flame-out pattern. If at any time in the approach the engine stops, retract the speed brakes and continue the same approach pattern to a safe landing.

### BELLY LANDING—ENGINE OPERATING.

If a normal landing cannot be made on a suitable airfield, a wheels-up landing is recommended according to the following procedure:

a. Dump wing tank fuel. Jettison external stores, if carried.

b. Use up excess fuel to establish an aft cg condition and minimize possible fire hazard.

c. Push longitudinal control system selector control down or move longitudinal control system selector switch to MANUAL.

d. Wing flaps—down. Reduce airspeed to approach speed.

e. Speed brakes—down. Extended speed brakes will cushion touch-down and minimize damage. Note that to extend speed brakes when the wing flaps are down, the speed brakes emergency landing override switch must be set to its emergency position.

f. Lock and tighten shoulder harness. Remove personal connections (oxygen, "G" suit, radio leads).

g. Open canopy.

h. Just before contact, retard throttle to CLOSED, set fuel master switch to OFF, and set battery switch to OFF.

i. Make a normal landing, touching down as slowly as possible.

j. Abandon airplane immediately after it stops.

### DITCHING—ENGINE OPERATING.

a. Dump wing tank fuel. Jettison external stores, if carried.

b. Use up excess fuel to establish an aft cg condition and to increase buoyancy in water.

c. Push longitudinal control system selector control down or move longitudinal control system selector switch to MANUAL.

d. Landing gear control lever—UP.

e. Wing flaps—down. Reduce airspeed to approach speed.

f. Lock and tighten shoulder harness. Remove personal connections (oxygen, "G" suit, radio leads).

g. Open canopy.

h. Arresting hook may be extended, if desired, to give slight warning just before touch-down.

i. If sea conditions are favorable, land into the wind. If swells are running, land along a swell.

j. Just before contact, retard throttle to CLOSED, set fuel master switch to OFF, and set battery switch to OFF.

k. Make a normal landing, touching down as slowly as possible in the nose-high attitude. Avoid high rates of descent in the final approach, since the airplane may not respond to flare-out immediately and may touch down hard.

l. Leave airplane as soon as forward motion definitely stops.

## LANDING EMERGENCIES.

### NOSE WHEEL UP OR UNLOCKED.

If the main landing gear is down, but the nose wheel is either up, or down but not locked, use up as much fuel as possible, drop external stores, if carried, and expend ammunition to get aircraft to an aft cg, as light as possible and reduce fire hazard.

a. Actuate emergency landing gear extension air bottle.

b. Check that shoulder harness is tight and locked.

c. Disconnect oxygen, radio leads and "G" suit.

d. Open canopy.

e. Extend speed brakes to minimize nose damage.

f. Accomplish a power-on, flaps-down approach, landing nose-high with as little sink speed as possible.

g. Move throttle to CLOSED just before touch-down.

**Note**

If nose wheel is down but not locked, it will sometimes lock on landing. Caution should be used not to drop in hard enough to rotate onto the nose gear.

h. Set fuel master switch to OFF.

i. Set battery switch to OFF.

j. Hold nose off until speed is reduced, but let nose down onto runway before elevator effectiveness is lost.

k. Use brakes only if absolutely necessary.

l. Abandon aircraft as soon as it stops.

### MAIN GEAR UP OR UNLOCKED.

If one or both main wheels are not down and locked, use up as much fuel as possible, drop external stores, if carried, and expend ammunition to get the airplane as light as possible and minimize fire hazard.

a. Actuate emergency landing gear extension air bottle.

b. Check that shoulder harness is tight and locked.

c. Disconnect oxygen, radio leads and "G" suit.

d. Open canopy.

e. Extend speed brakes to minimize nose damage.

f. Accomplish a power-on, flaps-down approach, landing nose-high with as little sink speed as possible.

g. Move throttle to CLOSED just before touch-down.

h. Set fuel master switch to OFF.

i. Set battery switch to OFF.

j. Hold airplane off as long as possible and, if one landing gear is down, land on the side of the runway next to the extended landing gear.

**Note**

If one main landing gear is down but not locked, it will sometimes be locked if the landing is made in a skid in the direction that will force the questionable landing gear outboard.

k. Abandon aircraft as soon as it stops.

### LONGITUDINAL ELECTRIC TRIM CONTROL SYSTEM FAILURE.

If the stabilizer electric trim system fails and if at a safe altitude, determine whether the airplane can be controlled in the landing configuration on manual elevator control. If control is unsatisfactory, the landing should be made on the powered longitudinal control system, keeping the wing flaps retracted (to avoid control shift into manual). With the flaps retracted, approach should be about 20 knots faster than with flaps down: i.e., maintain 140 knots IAS for field landings, 130 knots IAS for carrier landings. With 130 knots carrier approach airspeed, the wind over the deck must be high.

### BARRICADE ENGAGEMENT.

**WARNING**

Under unusual wing retardation barricade engagement conditions, such as free flight or severely yawed aircraft attitudes, it is possible for the upper loading strap to enter the open cabin. IT IS THEREFORE MANDATORY FOR PILOT SAFETY THAT THE PILOTS KEEP THEIR HEADS DOWN AND FORWARD IN THE CABIN WHEN BARRIER AND/OR BARRICADE ENGAGEMENT IS IMMINENT. Such action can aid substantially in keeping the pilot's head and shoulders away from the back of the seat and headrest where a barricade strap is most liable to lodge if it should enter the cabin.

## AIRSTART.

There are three possible procedures for obtaining an airstart, depending upon the prevailing conditions. These are the Normal Relighting in Flight, the Emergency Igniter Operating and the High Altitude, High RPM Relight Procedures.

### NORMAL RELIGHTING IN FLIGHT.

**Note**

All time delays mentioned in this section should be timed by clock.

If a definite flame-out has occurred, immediate relighting action must be carried out as follows:

a. Retard throttle to CLOSED.

**Note**

Due to the possibilities of flooding the engine with fuel and of fuel fouling the spark igniters, which might prevent the igniters from sparking, this action should be carried out immediately to shut off the fuel flowing into the combustion chambers. However, do not close the fuel master switch, as this may cause the fuel system to become airlocked when the engine is windmilling and prevent a start.

b. Check that battery switch is at BAT. & GEN. position.

**Note**

When generator cuts out during flight (below about 35% rpm), all circuits except those necessary for flight will be disconnected automatically. Pitot head heat, communications circuits etc, may be energized by setting the battery switch at BAT. Airstarts may be made with the battery switch in either BAT. & GEN. or BAT. position; BAT. & GEN. position is preferred to conserve power.

**WARNING**

Never set the battery switch to OFF under these conditions and, when changing the battery switch setting from BAT. to BAT. & GEN., or vice versa, move it through OFF position as rapidly as possible if it has been necessary to set the engine fuel system selector switch to EMER. Since the fuel control valve is held in the emergency system position electrically, setting the battery switch to OFF will release the holding solenoid and permit the control to return to the primary system, possibly causing another flame-out.

c. Set engine fuel system selector switch to START & PRIMARY position.

**Note**

Airstarts may be successfully performed with the engine fuel system selector switch in EMER. in cases where the primary fuel system is known to be malfunctioning or where all attempts to start the engine with the engine fuel system selector switch in the START & PRIMARY position have failed. The starting procedure, windmilling speed, and other conditions are the same for starts in either the START & PRIMARY or EMER. position.

d. Cycle engine start master switch, i.e., move engine start master switch to OFF in order to reset ignition timer before each relight attempt, but be sure to move it back to ON prior to relight attempt.

e. If above 25000 feet, reduce altitude to 25000 feet as fast as desirable, from a glide standpoint, to minimize engine cooling time and then level out at 25000 feet. If below 25000 feet at time of flame-out, hold flight at constant altitude.

**Note**

Although it may be possible to obtain partial relights using the normal relighting procedure above 25000 feet, flight testing has indicated that "hung" lights will result at higher altitudes. Therefore, do not attempt to obtain a relight above 25000 feet using the normal relighting procedure. See High Altitude, High RPM Airstart paragraph. At least 30 seconds should be allowed prior to starting relight procedure to permit proper clearing of the engine and spark igniters of residual fuel.

f. With airplane in level flight, airspeed and engine rpm will decrease rapidly. When airplane speed indicates 195 knots IAS, move throttle to START position to actuate spark igniter system and hold at START position for 10 seconds.

g. Continuing to hold airplane in level flight with speed decreasing, move throttle to the IDLE position. This step should be completed in range of airspeeds between (12-8% rpm) 190-160 knots IAS (engine rpm is controlled by airspeed).

h. Holding airspeed within 190-160 knots IAS range, allow 30 seconds for light-up. Observe tailpipe temperature gage and tachometer for indications of light-up.

i. When light-up is obtained, keep throttle in the IDLE position until engine has reached altitude idle speed.

**Note**

Idle rpm varies with altitude.

j. If no light-up is obtained in the 30 second period, or if engine does not continue to accelerate to idle rpm ("hung" light) in a reasonable time, retard throttle to CLOSED position to shut off fuel to engine and again cycle engine start master switch.

k. Increase speed to approximately 225 knots IAS by reducing altitude, level out again and repeat relight procedure, steps f. through j., above. This maeuver will probably take 3000 to 5000 feet altitude and should take sufficient time to permit proper clearing of engine and spark igniters of residual fuel (at least 30 seconds, 60 seconds desired).

### EMERGENCY IGNITER OPERATING PROCEDURE.

**Note**

All time delays mentioned in this section should be timed by clock.

All engines are equipped with two single-shot, shell type, manually operated, emergency igniter units as an additional safety device for use in any case of failure to relight with the normal air starting ignition system. It is important to note that only two ignition attempts are available with this emergency igniter system. The control is rigged so that the cartridges may be fired by the pilot either singly or in rapid succession, if desired. Therefore, these emergency igniters should be used only when attempts to ignite with the standard air starting ignition system have failed or when time permits only one or, at the most, two possible relighting attempts. Conditions should be as identical as possible to those listed in the following procedure before starts are attempted with the emergency igniters. All starting attempts should be made with a single igniter except under extreme circumstances when time will permit only one attempt, in which case both cartridges should be fired. The following procedure should be followed for all emergency igniter relight attempts:

a. Altitude—below 18000 feet. Do not attempt emergency igniter relight at any higher altitude.
Airspeed—160-190 knots IAS.
Engine fuel system selector switch—EMER.

b. Move throttle from CLOSED to IDLE.

c. Wait five seconds and pull out emergency igniter control.

**Note**

All starting attempts should be made with a single igniter except under extreme circumstances when time will permit only one attempt. In the latter case, both igniters should be actuated in rapid succession. This is done by pulling out the emergency igniter control to fire the first igniter cartridge, then rotating the control handle 90 degrees in either direction and pulling it to a stop to fire the second igniter.

d. Leave throttle at IDLE until engine has reached altitude idle speed.

It should be noted that emergency igniter starts may be accomplished by using either the START & PRIMARY or EMER. position. However, in view of the limited number of emergency igniter starting attempts available (two shells), starting in the EMER. engine fuel system selector position is recommended, unless the pilot suspects malfunctioning of the emergency fuel system.

**Note**

The procedures used with the emergency igniter system vary from those with the electrical ignition system in some details. Particularly to be noted is that with the emergency igniter system, the throttle should be placed in the IDLE position and a delay of five seconds allowed before discharging the igniter to insure time for fuel to flow into the combustion chambers. With the electrical ignition system, the throttle is moved to START and a delay of 10 seconds is made before it is moved to the IDLE position, to allow time for the spark igniters to become warm.

### HIGH ALTITUDE, HIGH RPM AIRSTART.

Relights have been accomplished using the procedure outlined below, up to altitudes of 38000 feet. As soon as a flame-out is positively identified, initiate the following procedure:

a. Immediately return throttle to CLOSED and push outboard to START.

b. Then, immediately push throttle forward into IDLE detent. Relight will occur within two to four seconds.

c. If relight does not occur in eight seconds, return throttle to CLOSED and descend to 25000 feet where a normal airstart procedure can be initiated. If the primary fuel system is believed to have failed, causing the flame-out, move the engine fuel system selector switch to EMER. simultaneously with the actions outlined in step a. At 35000 feet and below, the procedure must be accomplished before the rpm drops below 40%. Above 35000 feet a progressively higher rpm is necessary to obtain a relight and approximately 75% rpm is necessary at 38000 feet. The airstart procedure must be performed in about four seconds at 38000 feet to obtain a successful airstart. It is absolutely necessary, however, to move the throttle into the START detent before moving it to IDLE. The pilot must have the procedure well in mind in order to initiate this airstart procedure immediately after the flame-out occurs.

More extensive information on high altitude, high rpm airstarts will be furnished when available.

## FIRE.

### ENGINE FIRE ON GROUND.

If one or both of the fire warning light glow, indicating a fire in the engine compartment, or if there is other positive indication of fire:

a. Retard throttle to CLOSED.

b. Set fuel master switch to OFF.

c. After five seconds, set battery switch to OFF.

d. Leave cabin.

e. Use available fire extinguishers.

If fire is detected in tailpipe after a normal shut-down:

a. Call for external power.

b. Have ground crew observe fire for spreading (at a safe distance from end of tailpipe).

c. Perform a "clear engine", using procedure given in Clearing Engine paragraph in Section II.

### ENGINE FIRE IN FLIGHT.

If a fire should start in the engine compartment or aft sections of the airplane, the pilot will receive indications of it in at least one of the following ways:

a. One or both of the fire warning indicator lights will glow. Each light is connected to a separate circuit of fire detectors located at various points around the engine. When a fire warning light glows, it indicates that one of these detectors has been actuated.

b. Smoke or fumes in the cabin.

c. Visual indications of smoke or flame around the airplane or smoke trail behind the airplane.

d. Unusual engine roughness or muffled explosions.

e. Excessive tailpipe temperatures.

f. Information from wingman.

Usually a fire will make its presence known with more than one of the above indications. If only one indication appears, such as one fire warning light, fumes, smoke, or engine roughness, the trouble may not necessarily be a fire. Try to get at least two good indications for fire before taking emergency action.

If a fire is present, proceed as follows:

a. Retard throttle to CLOSED.

b. Set fuel master switch to OFF.

c. Make dead engine landing or abandon airplane.

### ELECTRICAL FIRE.

The probability of electrical fires has been minimized by the provision of circuit breakers and fuses to protect the electrical circuits. However, if an electrical fire does occur, try to identify the source of the fire and pull the appropriate circuit breaker if it has not popped of its own accord. If the fire persists, set the battery switch to OFF and land as soon as possible.

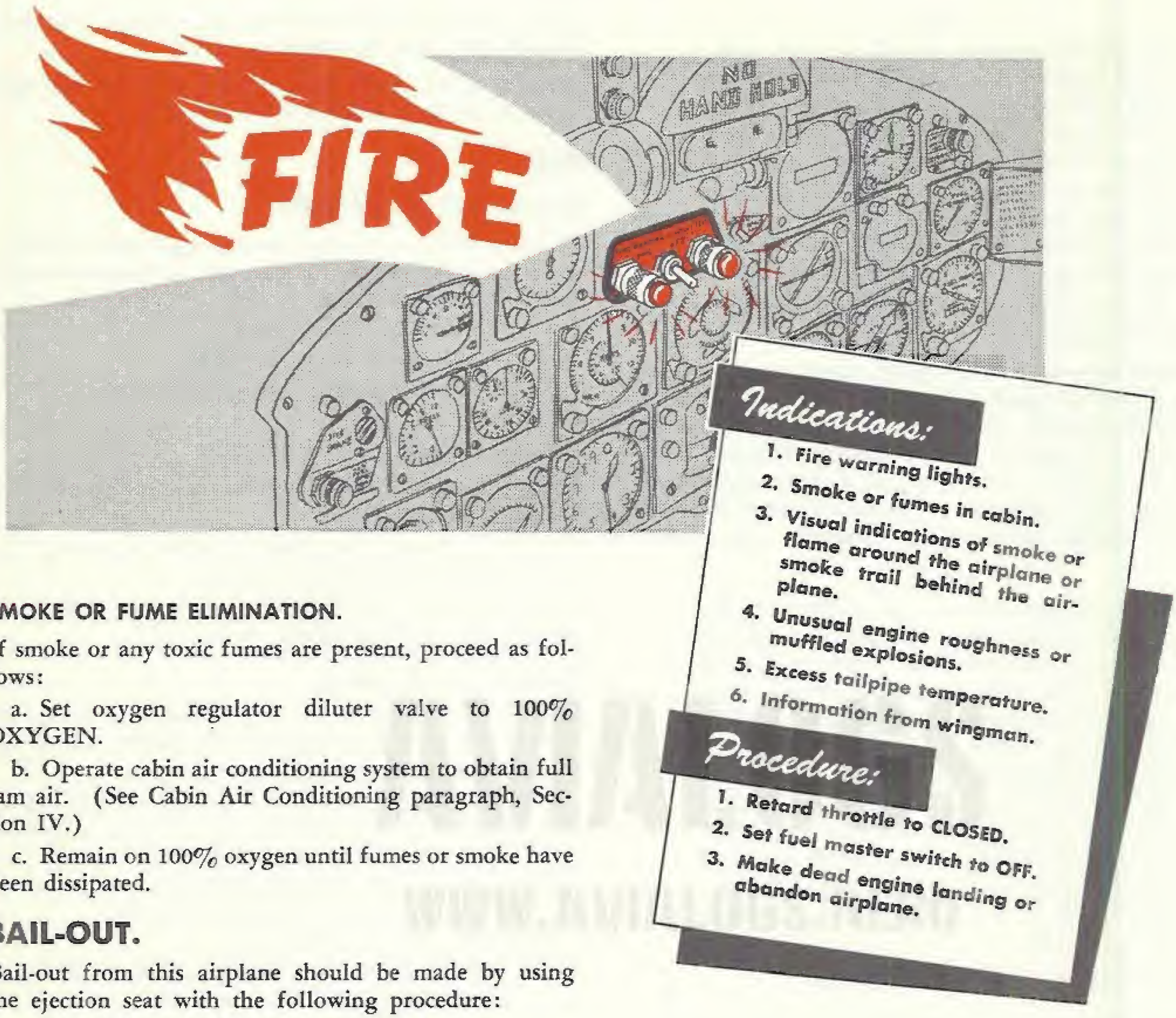



*Figure 3-4. Fire*

**SMOKE OR FUME ELIMINATION.**

If smoke or any toxic fumes are present, proceed as follows:

a. Set oxygen regulator diluter valve to 100% OXYGEN.

b. Operate cabin air conditioning system to obtain full ram air. (See Cabin Air Conditioning paragraph, Section IV.)

c. Remain on 100% oxygen until fumes or smoke have been dissipated.

## BAIL-OUT.

Bail-out from this airplane should be made by using the ejection seat with the following procedure:

a. REDUCE AIRSPEED IF POSSIBLE.

b. PULL PRE-EJECTION LEVER. Pull pre-ejection lever inboard, push it hard down and then push it outboard to lock. This jettisons canopy, releases knee braces, and pulls safety pin in seat catapult firing mechanism, but does not lower the seat. (The radio-oxygen tube is pulled off the console nipple fitting to which it is attached and the radio lead severed by the force of ejection when the seat has traveled upward a distance of about 12 inches. (The "G" suit hose connection is also separated during the initial upward travel of the seat.)

**WARNING**

Clearance between canopy and pilot's head is critical. Make sure head is below normal operating path of canopy before actuating pre-ejection lever.

An emergency ejection seat arming control is provided. Under certain extreme flight conditions, such as high negative "g", it may be difficult to reach and actuate the pre-ejection lever. For this condition, or one where the canopy fails to jettison, using the emergency ejection seat arming control will permit ejection through the canopy. This control is a red handle on the left side of the headrest and is attached to the cable which normally pulls the safety pin in the seat catapult firing mechanism. Pulling the control forward past the pilot's left ear pulls the safety pin and arms the seat. It does not lower the seat nor does it release the knee braces. For this type of ejection, hold knees together to prevent injury.

**WARNING**

Ejection through the canopy is feasible only with the canopy in the fully closed position. The canopy cannot be closed if the pre-ejection lever has been actuated.

c. PLACE FEET ON FOOTRESTS.

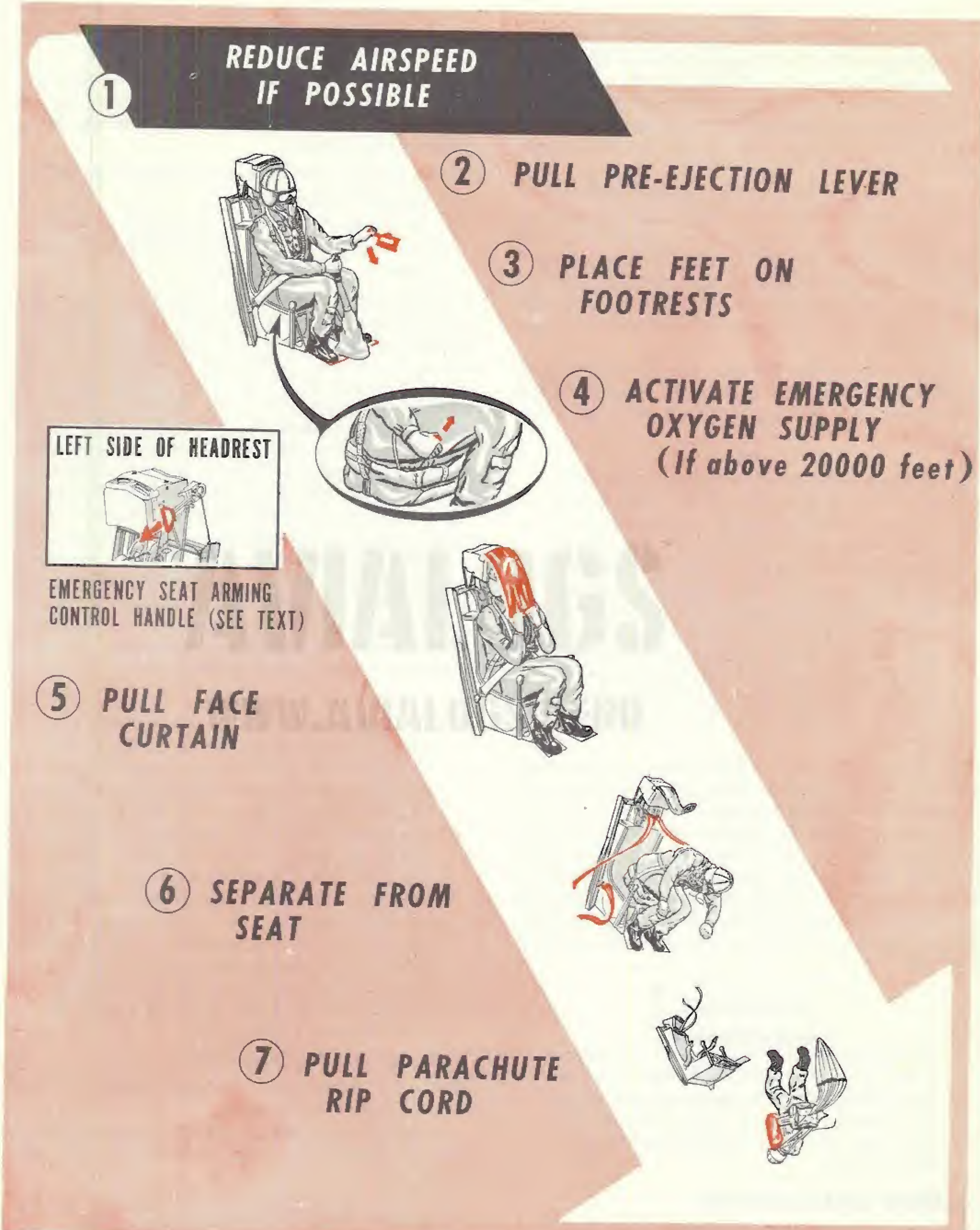



*Figure 3-5. Emergency Escape*

**Note**

The seat does not lower, but remains in a fixed position when the pre-ejection lever is pulled. The pilot may have to lift his feet up onto the footrests if the seat is in an elevated position.

d. ACTIVATE EMERGENCY OXYGEN SUPPLY. This action is necessary only at altitudes above 20000 feet.

e. PULL FACE CURTAIN. While continuing to control aircraft as much as possible, reach up with one hand and locate face curtain; then, sitting erect, with head back against headrest and muscles tensed to absorb ejection forces, reach up with the other hand and pull face curtain UNTIL FULLY EXTENDED. This will automatically lock the inertia reel and fire the ejection seat catapult.

f. SEPARATE FROM SEAT. Immediately following ejection, release face curtain, disconnect oxygen tube and radio leads, open lap belt, and roll forward out of the seat.

**Note**

If time permits, the oxygen tube and radio leads should be disconnected at the alligator clip coupling prior to ejection. If disconnection is not possible prior to ejection, the tube and the leads shall be disconnected prior to opening the lap belt to insure clean separation from the seat. When using ejection seat for emergency escape at 2000 feet or below, it is recommended that the lap belt be opened and the oxygen tube and radio leads be disconnected prior to ejection. This procedure will shorten the time required for separation from the seat after ejection.

g. PULL PARACHUTE RIP CORD. If above 2000 feet at time of separation from seat, delay at least five seconds before pulling rip cord. This delay will preclude any possibility of collision between the seat and parachute and will also result in a lower parachute opening shock. When the escape is accomplished at high altitude, it is recommended that the pilot free fall to an altitude of approximately 18000 feet before opening his parachute in order to avoid the effects of anoxia and cold.

**WARNING**

Do not pull rip cord while in seat. If ejection is aborted after pulling pre-ejection lever, the firing mechanism will be armed and care should be exercised not to pull the face curtain. The safety pin should be reinstalled immediately after landing.

## ENGINE EMERGENCIES.

### PRIMARY FUEL CONTROL FAILURE.

Failure or malfunctioning of the engine primary fuel control may be indicated in several ways:

a. Flame-out—usually without warning and without excessive throttle movement. Use relight procedure in emergency fuel control system.

b. Stuck or seized control—inability to change rpm.

c. Uncontrolled engine acceleration—rpm may increase slowly of its own accord from cruising rpm to 100% rpm or greater.

In cases b. and c., the emergency procedure is as follows:

a. Retard throttle to IDLE.

b. Set engine fuel system selector switch to EMER.

c. Open throttle slowly to obtain desired engine speed.

d. Land as soon as practicable.

A flame-out may occur during switchover from the primary to the emergency fuel control systems, particularly at high altitudes, if there is a large difference between the rpm on primary at the time of switchover and the idle rpm on emergency. If a flame-out does occur, use standard relight procedures. In case of uncontrolled acceleration, it is far better to risk the flame-out by switching systems than to risk damage to the engine by allowing it to run beyond its normal rpm and tailpipe temperature limits. Failure or malfunctioning of one of the engine driven fuel pumps will be indicated by the engine fuel pumps warning light. If this light glows, and no other symptoms of trouble are present, remain in the primary fuel control system, throttle back to a conservative cruise rpm, and land as soon as practicable. If this light glows, and other symptoms of trouble are present, follow the procedure for switching to the emergency fuel control system presented above.

**Note**

It is preferable to remain on the primary fuel control system rather than to switch to the emergency fuel control system because the primary system incorporates automatic acceleration and deceleration control. The emergency system consists simply of a metering valve in the fuel supply to the combustion chambers. When operating on the emergency fuel control system, both rpm and tailpipe temperatures must be watched carefully and kept within limits. Particular care must be used when changing altitude or when opening the throttle to increase power. High altitude operation is the most critical, as small throttle movements result in large changes in engine rpm.

### AIRPLANE FUEL SYSTEM FAILURE.

If the low fuel boost pressure warning light glows, it indicates one of the following:

a. Both the submerged fuel boost pump in the forward fuel cell and the engine driven fuel boost pump have failed, or

b. The low pressure fuel filter has become clogged and is by-passing unfiltered fuel to the main pumps.

The recommended procedure is to remain on the primary fuel control system, throttle back to a conservative cruise rpm, and land as soon as practicable.

### LOW FUEL QUANTITY.[1]

With less than 400 pounds of fuel indicated, special attention is required to maintain flight at low altitude. Attainable engine speed decreases as fuel is used (see figure 1-8). (Fuel flow will decrease from approximately 130 to 80 pounds per minute under these conditions.) The maximum attainable engine speed with 350 pounds of fuel is 92% rpm. The engine fuel pumps warning light will glow but should be ignored in this case. Obviously, the wave-off capabilities are decreased with less than 400 pounds of fuel indicated. It is recommended that a carrier landing be completed with at least 200 pounds of fuel remaining.

**Note**

The fuel quantities discussed above represent fuel quantity gage readings in level flight attitudes (including level coordinated turns).

During an optimum descent (figure A-8), or minimum time descent (figure A-9) and any other rapid, idle rpm descent, fuel starvation will not occur if the descent is started with sufficient fuel for the descent plus landing. (Example: Optimum descent, 40000 feet to sea level, 180 pounds of fuel; one circle and landing, 250 pounds; minimum fuel on board at touch-down, 200 pounds. Total required at 40000 feet, 630 pounds.)

### OIL SYSTEM MALFUNCTION.

If the oil pressure gage indicates abnormally low pressure, throttle back to lowest feasible rpm and land as soon as practicable.

If the oil pressure gage indicates zero, abnormally high pressure, or does not vary with rpm, replace the circuit fuse (right console, outboard of radio compass control panel). If trouble persists, follow procedure in preceding paragraph.

## HYDRAULIC SYSTEM EMERGENCIES.

### EMERGENCY HYDRAULIC SYSTEM OPERATION.

If there is insufficient pressure in the system to operate any of the units, set the selector valve control for the desired action and set the auxiliary hydraulic pump switch to ON. Hydraulic fuses are installed, which will isolate and make inoperable any system (i.e., landing gear, flaps, etc) in which a line break or leak occurs.

**Note**

It is possible that there may be a stoppage midway in the operation of one of the systems, caused by creeping of fuse valves. To overcome this, set selector valve to reverse action for an instant, then return it to setting for action desired.

### FLAPERETTE OPERATION.

If the flaperons become inoperative due to insufficient hydraulic pressure, the switchover to the flaperette system will be automatic. The only change the pilot will notice is a reduced rate of roll, since lateral control forces are the same for both the primary and emergency systems. The rate of roll on the flaperette system is approximately one-third of that attainable on normal flaperon control at approach speeds in the landing condition and 10 to 20% of that attainable on normal flaperon control at moderate to high speeds. In the event that automatic changeover to the flaperette system does not occur, changeover may be made by setting the flaperette system switch to EMER. & TEST.

### EMERGENCY FLAPERETTE SYSTEM.

The airplane is equipped with an engine driven flaperette hydraulic pump and an emergency flaperette air bottle system. During final approach to a dead engine forced landing, low windmilling engine rpm may not provide sufficient hydraulic pressure for unlimited use of the flaperettes for lateral control. To supplement output of the flaperette pump in this condition, and also to provide a source of pressure in the rare case of a frozen engine, causing failure of both the flaperon and flaperette systems, the emergency flaperette air bottle system is provided. Approximately 22 flaperette full deflection cycles are available when the system is turned on.

**Note**

If use of the emergency flaperette system is anticipated, it is recommended that the system be tested at a safe altitude and turned off, then turned on for the emergency landing at the start of the final approach. If test is performed, the number of cycles remaining may be several less than 22.

To be sure that lateral control is available through the complete landing, use rudder for lateral control down to an altitude of 500 feet, depending on air turbulence, at which point, actuate the flaperette air bottle system and use the flaperettes for lateral control in the normal manner.

### EMERGENCY FLYING TAIL SHIFT OPERATION.

In the event of loss of hydraulic system pressure, a safety feature is incorporated to shift longitudinal control automatically from the all movable, hydraulically powered flying tail to the manual elevator control system. The same shifting of control can also be selected by the pilot during any flight condition in the clean configuration, on some airplanes,[2] by pushing the longitudinal control system selector control knob down, or on other airplanes,[3] by moving the longitudinal control system selector switch from HYDRAULIC to MANUAL or by push-

[1]Airplanes ser No. 131063 through 131070.

[2]Airplanes ser No. 131063 through 131067, 131071, 131075 and subsequent.

[3]Airplanes ser No. 131068 through 131070 and 131072 through 131074.

ing the emergency manual control knob down. The time required for shiftover is approximately 1 to 1-1/2 seconds. During shiftover, both powered and manual systems are partially effective and there is no loss of control. The two control systems are adjusted with respect to each other so that when switching from the powered system to the manual system in straight and level flight, the nose of the airplane will rise slightly. If switchover is made during a turn or "g" maneuver, trim change during switchover will be small, but stick forces required to hold the same "g" will more than double. If switchover is made at very high Mach numbers, trim change will be small, but the effectiveness of the elevator will be low and electric stabilizer trim should be used as necessary to control the flight path of the airplane in recovering to level flight.

The components of the flying tail hydraulic system have a high level of reliability; however, if malfunctioning of the flying tail is suspected, as indicated by either a lack of response to stick movement, or uncalled-for operation with no stick movement, shift immediately to the manual elevator control system. Shut off power to the flying tail components by pushing down on the longitudinal control system selector control knob[1] or the emergency manual control knob.[2]

**Note**

Pushing the emergency manual control knob down not only shifts longitudinal control to manual elevator control, but also by-passes the 2-1/2 degree airplane nose-up trim limit circuit and the automatic retrimming feature with flap retraction. This last fact should be remembered in case of wave-off.

### EMERGENCY LANDING GEAR OPERATION.

If wheels fail to go down and lock when the normal control is moved to DOWN:

a. Check that airspeed is below limiting airspeed, 215 knots, and that hydraulic combat system shut-off valve control is at HYDRAULIC PRESSURE ON (full pressure to landing gear system), and check hydraulic system pressure gage. Recycle gear (move control lever to UP, then return to DOWN) to check hydraulic fuses.

b. Set auxiliary hydraulic pump switch to ON and wait for an interval. Extension will be slow.

c. If position indicator still does not show wheels down and locked, reduce speed to 160 knots, then pull and lock red "T" handle (handle shaft is notched to lock handle in release position) to lower wheels by air pressure. Landing gear will lower in approximately seven seconds.

**Note**

Once this system is used, the wheels will remain down and locked until pressure is relieved by a deck crew.

**WARNING**

In a situation which requires emergency landing gear extension, on airplanes which have Aircraft Service Change 217 incorporated, an effort should be made to lower the flaps prior to landing gear extension.

The normal hydraulic system pressure will be dumped to the return line when the emergency extension control handle is pulled.

### EMERGENCY SPEED BRAKE RETRACTION.

If difficulty is due to an electrical failure, retraction will occur automatically. If difficulty is due to hydraulic failure, impact air pressure will push up the speed brakes.

### EMERGENCY BRAKE OPERATION.

The brakes are provided with a separate hydraulic reservoir and will operate after a pump failure or line failure elsewhere in the hydraulic system. The brakes are hydraulically boosted, however, and loss of hydraulic system pressure will make brake pedal forces about three times heavier.

**CAUTION**

Since the air bottle pressure locks the brakes, do not use the emergency system if normal brakes will stop the airplane. If the air bottle is pulled while moving faster than 50 knots, blown tires will probably result. Braking effectiveness with blown tires is poor.

## ELECTRICAL SYSTEM EMERGENCIES.

### INDIVIDUAL CIRCUIT FAILURES.

If any electrical circuit fails to function, check that the appropriate circuit breaker reset button is in.

**CAUTION**

If button pops out repeatedly, do not attempt to hold it in, since continued use of the circuit may cause fire. Set the switch for that circuit off, if feasible.

### GENERATOR FAILURE.

Generator failure will be indicated by the generator warning light and reduced voltage on the voltammeter. All circuits except those essential to flight (essential bus) will be automatically disconnected if the battery switch is in BAT. & GEN. position and the landing gear control handle is in the UP position. Setting the battery switch to BAT., or setting the landing gear control handle to the DOWN position, will supply battery power to all circuits. Since the battery is the only source of power, it should be conserved by pulling all unneces-

[1]Airplanes ser No. 131063 through 131067, 131071, 131075 and subsequent.
[2]Airplanes ser No. 131068 through 131070 and 131072 through 131074.

sary circuit breakers when operating on battery power alone. (See figure 1-9 for detailed information.)

**WARNING**

Never set the battery switch to OFF except in case of an electrical fire.

#### TRIM FAILURES.

STABILIZER.

If the stabilizer electric trim malfunctions, as indicated by either a lack of response to movements of the trim button on the control stick, or by uncalled for operation with no movement of the trim button, immediately set the electrical trim selector switch on the left console from NORM. to EMERG. and use the emergency trim switch on the left console for trim control. If a landing must be made with the stabilizer trimmed to the airplane full nose-down position, due to a trim system malfunction, it is recommended that the landing be made using the powered longitudinal control system with the flaps up, for better longitudinal control effectiveness.

WING OR RUDDER TRIMMER FAILURES.

There are no emergency procedures for failures in the wing trimmer or rudder trimmer systems, since they can be overpowered with normal flight controls.

Power for the wing trimmer passes through the stabilizer primary control circuit breaker on the right side of the seat bulkhead. If this circuit breaker pops or is pulled intentionally, the trim button on the control stick will become inoperative. In this case, place the electrical trim selection switch from NORM. to EMER. and use the emergency trim switch for stabilizer trim.

Power for the rudder trimmer passes through the flight instruments circuit breaker. If this circuit breaker pops or is pulled intentionally, certain flight instruments (landing gear position indicator, absolute stabilizer position indicator, speed brakes position indicator and G-2 compass) will become inoperative.

### EMERGENCY ARMAMENT CONTROL.

To stop runaway guns, set armament master switch to OFF or inboard and outboard gun charging switches to SAFE.

### EMERGENCY DROP TANK JETTISON PROCEDURES.

#### ELECTRICAL CONTROLS.

a. Set rack selector switch to LEFT, RIGHT, or BOTH.

b. Set armament master switch to ON.

c. Press bomb release switch.

#### HYDRAULIC CONTROLS.

a. Set stores emergency release lever to LEFT WING, BOTH, or RIGHT WING.

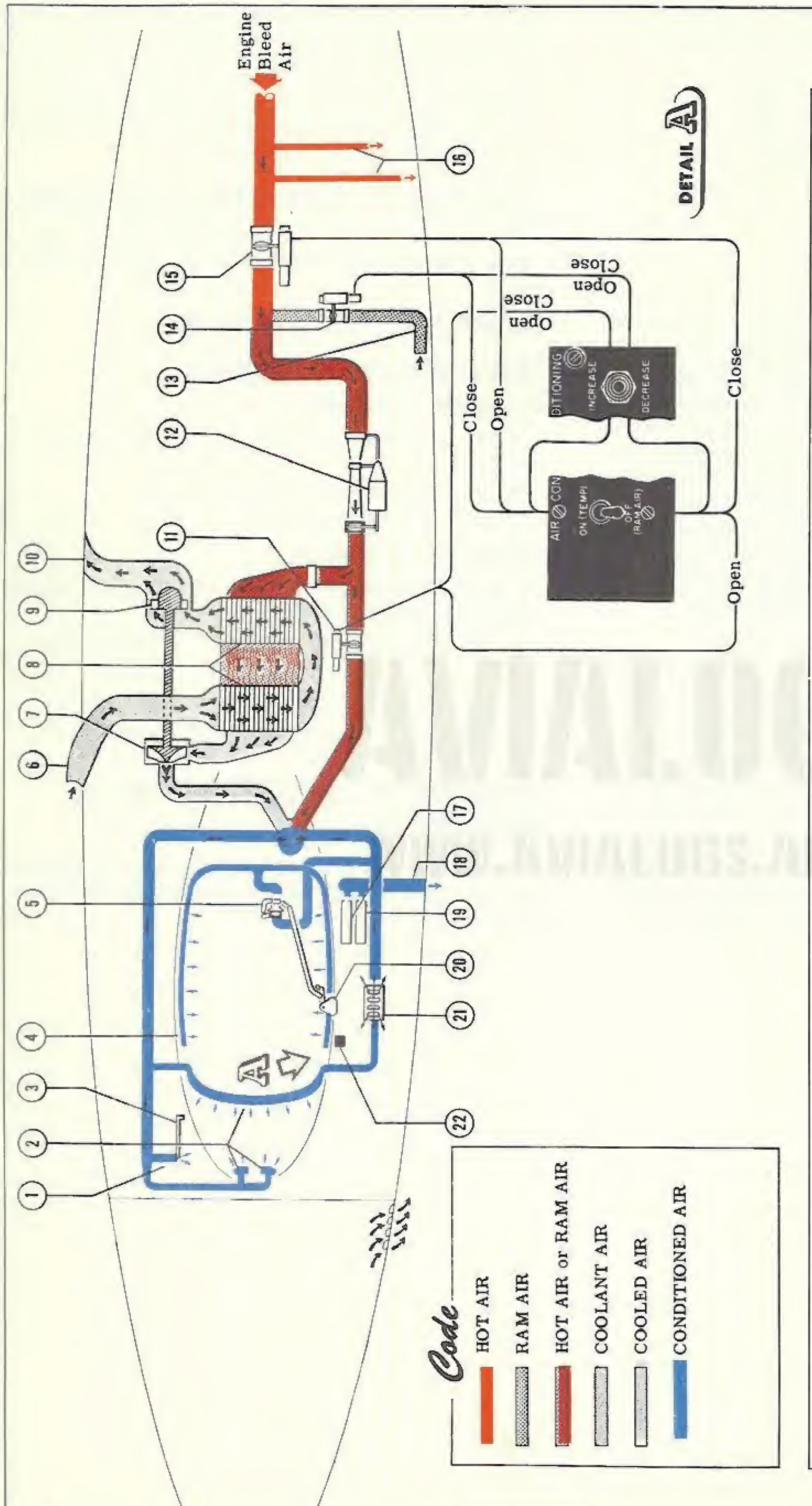
b. Pull stores emergency release "T" handle aft.

**Note**

Jettisoning of drop tanks and other external stores has not been tested and is not recommended at this time.

### EMERGENCY OPERATION OF IFF EQUIPMENT.

To indicate emergency or distress, press the dial stop and rotate the master selector to the EMERGENCY position.




1. Foot Outlet
2. Windshield Defroster Outlets
3. Foot Outlet Control
4. Canopy Defroster Outlet
5. Canopy Defroster Shut-off Valve
6. Coolant Air Scoop
7. Coolant Fan Turbine
8. Refrigeration Unit
9. Coolant Fan
10. Coolant Air Exhaust
11. By-pass Valve
12. Flow Control Valve
13. Ram Air Scoop
14. Ram Air Shut-off Valve
15. Main Shut-off Valve
16. Engine Bleed Air to Pressurize Hydraulic Tanks and "G" Suit and Operate Turn and Bank Indicator
17. Cabin Pressure Manual Dump Valve
18. Pressure Regulator and Dump Valve Exhaust
19. Cabin Pressure Regulator Valve
20. Canopy Defroster Shut-off Valve Control
21. Console Outlet and Control
22. Console Air Conditioning System Control Panel

*Figure 4-1. Air Conditioning System Schematic Diagram*


## CABIN AIR CONDITIONING SYSTEM.

Hot, high pressure air is provided by the engine compressor. Part of this air is passed through a refrigeration unit and cooled, then mixed with the remainder and fed to the cabin. Cabin temperature is regulated by the ratio of hot air to cool air. This regulation is accomplished by the use of a valve that controls the amount of engine air that by-passes the refrigeration unit. The amount of air fed into the cabin varies with engine rpm and altitude. A cabin pressure regulator maintains pressure control by venting the excess air. The cabin is pressurized only above 5000 feet (figure 4-2); however, temperature control is available on the ground as well as at any altitude.

### NORMAL CONTROLS.

#### SYSTEM CONTROL PANEL.

The air conditioning system control panel, located on the left console, contains the system on-off (temperature-ram air) and the increase-decrease switches.

#### SYSTEM ON-OFF SWITCH.

This switch permits the pilot to select conditioned air or ram ventilating air for the cabin. The switch may be set to either the ON (TEMP) position, which provides temperature control, or the OFF (RAM AIR) position, which provides ventilation.

#### INCREASE-DECREASE SWITCH.

When the on-off switch is in the ON (TEMP) position, the two position momentary (center off) increase-decrease switch permits the pilot to regulate the ratio of hot to cool air entering the cabin. This switch operates the by-pass valve. Full valve adjustment is made in 20 seconds. When the switch is held at INCREASE, the by-pass valve opens and allows more hot air to enter the cabin, thus increasing the cabin temperature. When the switch is held towards DECREASE, the valve closes and more air is forced through the refrigeration unit, thus decreasing the cabin temperature.

When the on-off switch is set in the OFF (RAM AIR) position, the increase-decrease switch permits the pilot to regulate the amount of ram ventilating air that enters the cabin. Holding the switch at INCREASE opens the ram air valve, and holding the switch towards DECREASE closes the valve, thus regulating the amount of ram air. The ram air valve will be closed when the on-off switch is first placed in the OFF (RAM AIR) position. Full valve adjustment is made in approximately four seconds.

#### MANUAL CABIN AIR OUTLET CONTROLS.

The controls consist of a sliding cover plate controlling an outlet on the right side forward of the console, at the pilot's feet, and a sliding shutter regulating a louvered outlet on the left console. The volume of ventilation air entering the cabin from these outlets may be regulated as desired by adjusting the respective control (29, figure 1-4 and 9, figure 1-3).

#### CANOPY DEFROSTER SHUT-OFF VALVE CONTROL.

This control consists of a lever mounted on the left side of the canopy. It is connected through a mechanical linkage to a butterfly valve in the canopy defroster duct. Pushing the lever forward to OFF closes the

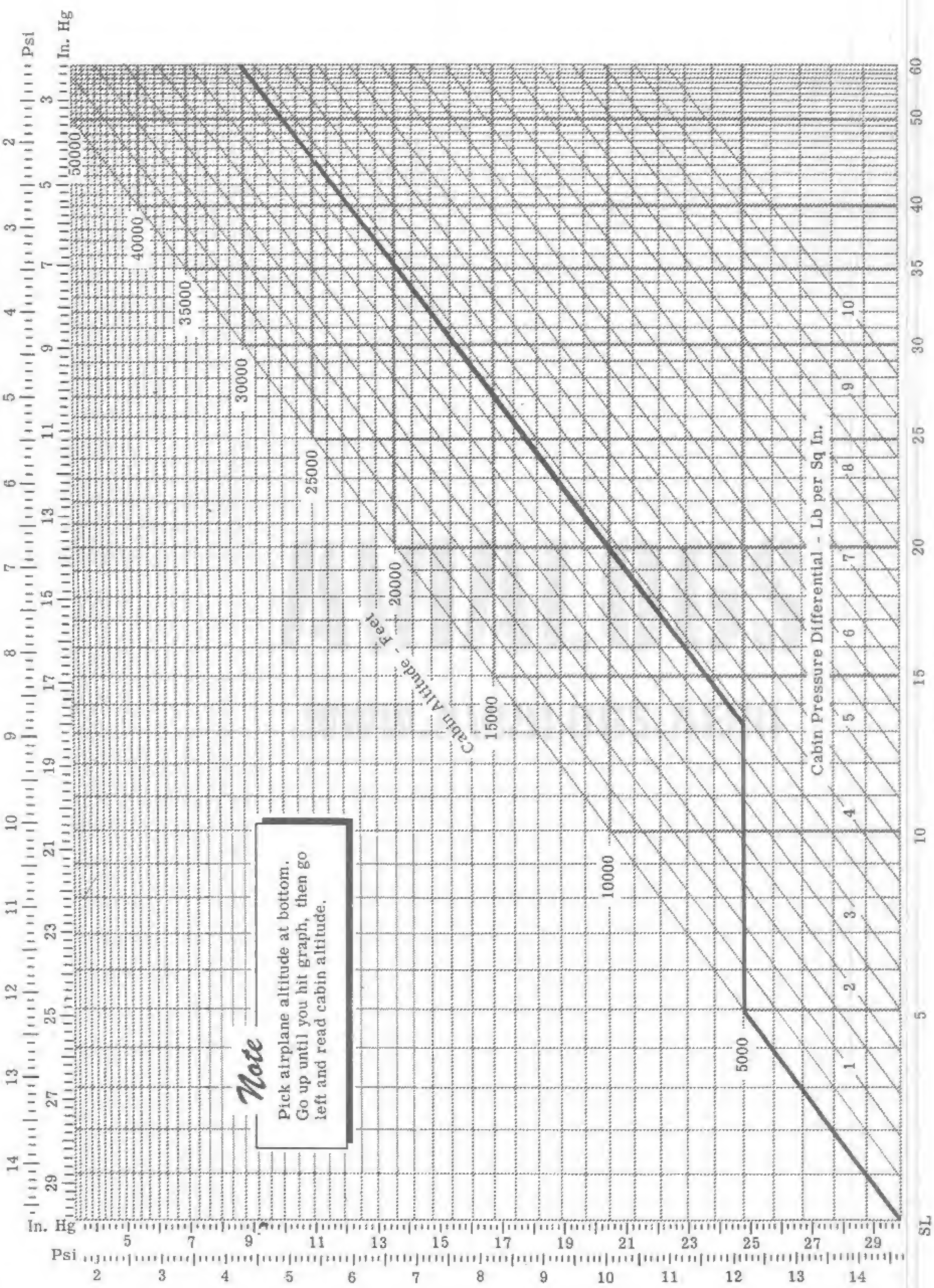



*Figure 4-2. Pressurizing Schedule*

valve and moving it aft to ON opens the valve (7, figure 1-3).

**Note**

For maximum windshield defogging and defrosting, particularly when descending from high altitude into warm humid air, manually adjust the cabin air to full and close the foot, console and canopy valve outlets before starting descent. This will force the maximum amount of hot air to the thick armor glass without excess heat to the pilot. After descent, readjust temperature as dictated by frost or pilot comfort.

### EMERGENCY CONTROL.

CABIN PRESSURE DUMP VALVE.

The cabin pressure dump valve lever (8, figure 1-4) is mounted on the left side of the bulkhead behind the pilot's seat. Pulling the lever inboard instantly dumps the cabin pressure, and pushing it outboard restores pressure. Cabin temperature control is still available after the pressure has been dumped.

### INDICATOR.

CABIN PRESSURE ALTIMETER.

This instrument is mounted on the forward end of the right console. It indicates the cabin pressure altitude and serves as a check for the proper operation of the cabin pressurization system (2, figure 1-5 figure 4-2).

### OPERATING INSTRUCTIONS.

a. Set on-off switch to ON (TEMP) if temperature control and cabin pressurization are desired, or to OFF (RAM AIR) if ram air ventilation only is desired.

b. Move momentary increase-decrease switch to position which will produce the state of air conditioning desired for optimum pilot comfort.

**Note**

Under certain atmospheric conditions of high temperature and humidity, chiefly at low altitudes, the cabin air conditioning system outlets will emit fog. This fog becomes thicker as the cabin temperature falls, but can be eliminated by setting the on-off switch to ON (TEMP) and moving the increase-decrease switch to INCREASE. The fog may be dense enough to resemble smoke; therefore, to avoid cause for undue alarm until the pilot has become accustomed to the characteristics of the air conditioning system, take-offs should be made with the on-off switch set to OFF (RAM AIR) and the quantity of ventilating air required to clear the cabin controlled by the increase-decrease switch.

c. For ram air ventilation, set on-off switch to OFF (RAM AIR) and pull cabin pressure dump valve lever inboard. Regulate quantity of ventilating air by holding increase-decrease switch at INCREASE positions until desired flow of ram air is obtained.

d. To dump pressure, pull dump control handle (left of seat) inboard; to restore pressure, push outboard.

### PRESSURIZING EQUIPMENT EMERGENCY OPERATION

In case of excessive pressure, pull dump control handle, located to the left of the seat, inboard to dump pressure. Cabin heating and ventilating remain available. In case of excessive cabin temperature, set on-off switch to OFF (RAM AIR) and move increase-decrease switch to INCREASE. When temperature has been reduced, attempt to regain desired cabin air condition. If ineffective, return to OFF (RAM AIR) position.

## ELECTRONIC EQUIPMENT.

TABLE IV-1. COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT.

| *Type* | *Designation* | *Function* | *Range* | *Location of Controls* |
|---|---|---|---|---|
| UHF Transmitter-Receiver | AN/ARC-27 | Two way voice communication | Line of sight | Right Console |
| Homing Adapter | AN/ARA-25 | Navigation or homing | Line of sight | Right Console (See Note) |
| Radio Compass | AN/ARN-6 | Navigation (ADF) | 100 statute miles | Right console (Indicator on instrument panel) |
| IFF Equipment | AN/APX-6 | Identification | Line of sight | Right console |
| Gun Ranging | AN/APG-30 | Range indication for sight unit | 3000 yards max | Left console |

**Note**

The AN/ARA-25 system utilizes AN/ARC-27 controls and the course indicator.

### AN/ARC-27 UHF COMMAND SYSTEM.

The AN/ARC-27 command equipment provides AM. radio communication between the airplane and any other station similarly equipped within the ultra high frequency range of 225.0 to 399.9 megacycles. In addition, this equipment may be operated as a navigational aid when used in conjunction with AN/ARA-25 equipment (see AN/ARA-25 paragraph). In this system, 1750 channels are available to the pilot, 20 of which are preset. In addition a guard channel frequency is available. The system consists of a receiver-

transmitter, a console control panel, an antenna and associated wiring.

CONTROLS.

The console control panel provides the controls for operating the AN/ARC-27 uhf command system and the AN/ARA-25 homing adapter. These controls are: the OFF-T/R-T/R+G-ADF selector switch, a VOL control, a SENS control, a CHAN selector switch, three rotary decade frequency selector dials, and a mechanical push button.

The OFF-T/R-T/R+G-ADF selector switch turns on the equipment when advanced from the OFF position. When set to T/R, only the receiver-transmitter operates, and when set to T/R+G the receiver-transmitter operates together with the guard receiver. In the ADF position, the uhf homing adapter is put into operation. When set to ADF, the receiver-transmitter is still in an operational condition on whatever channel or frequency is set by the CHAN selector switch or rotary decade frequency selector dials. The VOL control is used to adjust the output of the receivers and the SENS control is used to reduce audio background noise to a minimum.

The CHAN selector switch is used to select any one of 20 preset channels and one preset guard channel. When set to M, the three rotary decade frequency selector dials may be used to select any desired frequency without danger of changing the preset channels.

The mechanical push button marked PUSH TO SET CHAN is used in conjunction with the rotary decade frequency selector dials to preset any desired frequency on any desired setting of the channel selector switch (see Channel Preset Procedure paragraph).

**CAUTION**

Do not press the mechanical push button in unless setting up a specific frequency. Switch is mechanical and does not require that the equipment be on to change preset settings.

CHANNEL PRESET PROCEDURE.

a. Set CHAN selector switch to 1.

b. Rotate the three rotary decade frequency selector dials to the desired frequency (indicated in line with the frequency selector pointer).

c. Turn the mechanical push button clockwise to its stop, and push in.

d. Repeat preceding steps for setting each desired channel. The G position on the channel selector switch is used for the guard channel.

**Note**

Do not set up any frequency outside the specified range of the equipment.

e. If possible, check settings by establishing two way communication on new frequencies.

OPERATION.

a. Set the OFF-T/R-T/R+G-ADF selector switch to T/R.

b. Set the CHAN selector switch to desired channel. In approximately one minute, signals above the squelch level will be heard.

c. Adjust VOL control to desired level and adjust SENS control to reduce background noise.

d. To receive signals on the guard channel and the selected channel, set the OFF-T/R-T/R+G-ADF selector switch to T/R+G.

e. To transmit on channel selected, depress microphone switch. Sidetone will be heard in headset.

f. To transmit on guard channel, set CHAN selector switch to G and depress microphone switch.

g. To turn equipment off, set OFF-T/R-T/R+G-ADF selector switch to OFF.

**AN/ARA-25 UHF HOMING ADAPTER.**

This system is used in conjunction with the AN/ARC-27 command set to serve as a homing or navigational aid by providing a continuous indication of the true bearing of an r-f signal source transmitted by another airplane, surface craft or ground station on a frequency range of 22.0 to 399.9 megacycles. The true bearing is indicated by the number 1 pointer on the course indicator mounted on the instrument panel.

**Note**

The rotating compass card on the course indicator indicates the airplane's magnetic heading at the marker at the top of the indicator. The signal feeding the compass card is derived from the G-2 compass equipment.

Whenever the OFF-T/R-T/R+G-ADF selector switch on the AN/ARC-27 control panel is set to the T/R or the T/R+G position, the AN/ARA-25 equipment is automatically put in the stand-by condition. When this selector switch is set to ADF, the AN/ARC-27 equipment is placed in circuit with the homing equipment, enabling the latter to receive the frequency selected by the CHAN selector switch on the AN/ARC-27 control panel.

**Note**

When the OFF-T/R-T/R+G-ADF selector switch is set to ADF, AN/ARN-6 radio compass information is indicated by the number 2 pointer on the course indicator, while the AN/ARA-25 information is indicated by the number 1 pointer. When this switch is set to either T/R or T/R+G, or when the microphone switch is depressed to transmit, uhf homing information will be switched off automatically leaving only radio compass information displayed on the course indicator.

OPERATION.

**Note**

The G-2 compass equipment must be operating in order to obtain true compass bearing from the course indicator.

a. Set the OFF-T/R-T/R+G-ADF selector switch on AN/ARC-27 control panel to ADF. After three minutes, a background noise will be heard in headset indicating that equipment is operating.

b. Set CHAN selector switch on AN/ARC-27 control panel to frequency of known station.

c. Number 1 pointer on course indicator will give the true bearing of the station and audio from the station will be heard in the headset.

d. Homing equipment will revert to stand-by condition when microphone switch is depressed to transmit or when OFF-T/R-T/R+G-ADF selector switch is moved to T/R or T/R+G.

e. To turn off the equipment, set OFF-T/R-T/R+G-ADF switch to OFF.

## AN/ARN-6 RADIO COMPASS.

The equipment will perform the following three major functions:

a. Homing compass operation.

b. Position finding, using automatic and aural-null methods.

**Note**

On the course indicator, the number 1 pointer is used with the AN/ARA-25 homing equipment and the number 2 pointer is used with the AN/ARN-6 radio compass equipment. If both equipments are being used simultaneously, the pointers will indicate the bearings of the stations being received by their respective equipments. When the AN/ARA-25 homing equipment is turned off, both pointers will indicate the same AN/ARN-6 radio compass information.

c. Receiver operation, with function switch at ANT. or LOOP.

### HOMING COMPASS OPERATION.

To use as a homing compass, perform the following operations:

a. Turn function switch to COMP.

b. Rotate band switch to frequency band in which operation is desired.

c. Turn tuning crank to desired station frequency and tune for maximum swing of tuning meter. Greater accuracy in tuning may be obtained by setting CW-VOICE switch to CW. A 900 cycle tone will be heard along with the station modulation; this will aid in accurate tuning. After tuning, return CW-VOICE switch to VOICE to eliminate the 900 cycle tone.

d. Adjust VOLUME control for desired headset level.

e. Listen for station identification to be sure that correct station is being received.

f. The course indicator number 2 pointer will show the true bearing of the station.

### POSITION FINDING.

There are two methods of position finding: automatic and aural-null. Prior to using either method, perform the following steps to shorten the time required for a complete set of readings:

a. Select three stations whose geographical locations are spaced at approximately equal intervals about the airplane.

b. Tune in the stations, identify them and log their dial frequencies.

### AUTOMATIC METHOD.

For operation as an automatic indicating position finder, perform the following operations:

a. Set function switch to COMP.

b. Tune in one of the selected stations and record the bearing as indicated by the tail of the course indicator number 2 pointer.

c. Repeat step b. for the other stations, in rapid successions, while flying with a steady level heading.

**Note**

Because of the airplane's motion, the less time taken for observations, the greater the accuracy of the fix.

d. The recorded bearings will be the station-to-airplane bearings from the north. Project lines from the stations at the recorded bearings. The airplane position will be within the vicinity of the small triangle made by the intersection of the projected lines.

### AURAL-NULL METHOD.

For operation as an aural-null position finder, perform the following operations:

a. Set function switch to LOOP.

b. Tune in desired station. To obtain good signal strength for station identification, it may be necessary to rotate the loop by means of the LOOP L-R switch for maximum signal. Direction and speed of loop's rotation are controlled by direction and amount of LOOP L-R switch rotation.

c. Use the LOOP L-R switch, as in step b., and rotate loop for minimum headset volume. Record the bearing shown by the course indicator number 2 pointer. Better definition of the null may be obtained by turning the VOLUME control fully clockwise and locating the null by either listening for minimum audio signal or noting a counterclockwise dip of the tuning meter pointer. The use of cw operation also improves the definition of the null. To obtain cw operation, set the CW-VOICE switch to CW.

d. Position finding in loop operation is subject to a 180 degree error, since there are two null points in a 360 degree rotation of the loop. This ambiguity is overcome by keeping aware of your general geographical location and by selecting stations located well to the left and right of your course. Take, for example, a flight on a north course with station A supposedly dead ahead. If the course indicator shows a bearing of 180 degrees when station A is used, you apparently have passed station A and are flying away from it. This indication could also be the result of using the wrong null.

However, you know station B is to your left and station C is to your right, so by taking null point bearings on stations B and C, projecting lines through the stations at angles indicated by their bearings relative to north until they cross, you determine your approximate position. You then know whether you actually have passed station A or whether you have used the wrong null.

RECEIVER OPERATION.

SENSE ANTENNA RECEPTION.

a. Turn function switch to ANT.

b. Turn band switch to desired frequency band.

c. Set CW-VOICE switch to CW position for aural reception of unmodulated signals.

d. Tune in desired station.

e. Adjust VOLUME control for desired headset volume.

**Note**

For best definition of radio range stations, adjust VOLUME control for lowest usable headset volume and continue to reduce volume as the A-N signals increase in strength.

LOOP RECEPTION.

If sense antenna reception is noisy due to static, better results may be obtained by operating with the loop as follows:

a. Turn function switch to LOOP.

b. Turn band switch to desired frequency band.

c. If station is unmodulated, set CW-VOICE switch to CW.

d. Tune in desired station.

e. Rotate loop with LOOP L-R switch until maximum signal is obtained. If flight course is not straight, readjustments may be necessary.

f. Adjust VOLUME control for desired headset volume.

g. For best definition of radio range A-N signals using the loop, it is necessary to maintain the loop near the 90 or 270 degree position and adjust the VOLUME control for lowest usable headset volume.

**Note**

Cone of silence indications are not always reliable while receiving with the loop. In some cases, an increase instead of a decrease in signal may be noted. This is the result of certain types of radio range transmitting antennas and the loop location on the airplane.

SUMMARY OF PRECAUTIONS DURING OPERATION.

a. Select radio stations that provide stable bearings. Do not use a station for bearing unless it can be identified by headset signal with function switch set to COMP. High powered, clear channel stations should be used when possible. Any interference from other stations will cause an error in bearing. Tune equipment accurately. Station identification must be checked, especially stations broadcasting network programs. Avoid taking bearings on synchronized stations except when close to desired station. If station stops transmitting or fades, bearings may change to other stations of the same frequency, thus causing errors. This is especially true of code stations operating in a network.

b. Night effect or reflection of radio waves from the sky may be recognized by fluctuations in bearings. Night effect is worse at sunrise and sunset. The higher the frequency of operation, the greater the night effect. It may be present at distances over 20 miles when receiving 850 to 1750 kilocycle stations; however, with 100 to 450 kilocycle stations, reliable bearings above 200 miles can be taken even when night effect is present. The remedies for night effect are: increase altitude, thereby increasing signal strength of direct waves; use stations operating on lower frequency and take an average of the fluctuations.

c. Mountain effect is considered to be the reflection of radio waves from mountain surfaces. It is known to exist around Salt Lake City and Pittsburgh. Do not rely on bearings taken in such areas.

d. For aural reception of A-N signals, operate equipment with function switch at ANT. or LOOP instead of COMP., since the action of automatic valve control in COMP. position will cause broad course indications. Always operate the equipment with VOLUME control set at lowest usable headset volume and reduce it as the A-N signal strength increases. Cone of silence indications are not always reliable when operating the equipment using the loop. Use equipment with sense antenna for cone of silence indication.

e. This equipment should provide compass bearings during conditions of moderate static which interrupt normal reception. When static becomes too severe, it will be necessary to operate using the loop. In this position satisfactory aural reception and aural-null direction finding will be possible most of the time.

f. Do not depend on two stations for fix of location. Use at least three stations, with bearings spaced at approximately equal intervals throughout 360 degrees, for greatest accuracy.

g. While taking bearings, always keep airplane on a steady level heading.

h. When homing or direction finding using loop, there is 180 degree ambiguity, and station bearings may be 180 degrees from the null obtained. Use stations with good signal strength for sharply defined nulls. Width of null may be controlled by position of VOLUME control. The tuning meter may be used as a visual-null indicator.

**AN/APX-6 IFF EQUIPMENT.**

PURPOSE.

The radar identification set AN/APX-6 is an airborne transponder and is one of several equipments which may be operated together to provide a system of electronic identification and recognition. The purposes of the AN/APX are:

a. To identify the airplane in which it is installed as friendly when it is correctly challenged by an interrogator-responser associated with friendly shore, shipboard and airborne radars.

b. To permit surface tracking and control of airplane in which it is installed. Functionally, the AN/APX-6 receives challenges which are initiated by an interrogator-responser and transmits replies back to the interrogator-responser, where the replies are displayed, along with the associated radar targets, on the radar indicator. When a radar target is accompanied by a proper IFF reply, as transmitted by the AN/APX-6, that target is considered friendly.

OPERATION.

All controls required for operation of AN/APX-6 equipment are located on the control panel on the right console.

a. To turn equipment on, rotate MASTER selector switch to NORM.

b. To indicate emergency or distress, press red dial stop and rotate MASTER selector switch to EMERGENCY.

**Note**

The following is a suggested technique for right hand, rapid operation of the MASTER selector switch to obtain emergency operation: grasp the knob between the knuckles of the first and second fingers, at the same time pressing the dial stop with the thumb, and rotate the switch to EMERGENCY position.

c. To maintain the equipment ready for instant use, but inoperative, rotate the MASTER selector to STDBY.

d. The detent position labeled LOW on the MASTER selector switch should not be used except upon proper authorization.

e. The switches labeled MODE should be set to their OUT positions unless otherwise directed by proper authority.

f. To turn off the equipment, rotate the MASTER selector to OFF.

## LIGHTING EQUIPMENT.

### EXTERIOR LIGHTING SYSTEM.

The exterior lighting system receives power from the main bus and is controlled by switches grouped on the exterior lights control panel on the right console (4, figure 1-5). Toggle type selector switches with the positions BRIGHT, OFF, and DIM are provided for the formation, fuselage, tail position, and wing position lights. The master switch controls the exterior lights for manual, code, flash, or steady operation, depending on switch position. A code selector switch permits automatic signaling in code with the fuselage lights. Manual signaling is accomplished by a keying switch. The flasher-coder unit performs the dual function of alternately flashing the wing position, fuselage and tail lights and automatically flashing the fuselage lights in code according to the letter selected on the code selector switch. When the exterior lights master switch is in any on position, and the wheels are down and locked, the flasher-coder will automatically flash the approach light if the arresting hook is not down. In addition, an exterior lights auxiliary master switch is provided. This switch must be set to ON for all normal exterior lights operation. When desired, as for catapult signaling, the master switch and individual exterior light switches are placed in their selected positions with the auxiliary master switch set to OFF. The exterior lights may then be turned on quickly by setting the auxiliary master switch to ON. Circuit protection is afforded by two EXT. LIGHTS circuit breakers located on the main circuit breaker panel and fuses on the right console.

CONTROLS.

EXTERIOR LIGHTS AUXILIARY MASTER SWITCH.

This switch, mounted on the electrical control panel on the right console (45, figure 1-5), is a two position ON-OFF toggle switch, wired in series with the exterior lights master switch. It must be set to ON for exterior light operation.

EXTERIOR LIGHTS CONTROL PANEL.

The exterior lights control panel is installed on the right console. The panel contains a master switch, a code selector switch, a keying switch, an indicator light, and individual light switches for selective control of the formation, fuselage, and wing position light circuits.

EXTERIOR LIGHTS MASTER SWITCH.

The exterior lights master switch is located on the exterior lights control panel and is of the rotary type, with OFF, MAN, CODE, FLASH, and STDY positions. The OFF position deenergizes all exterior light circuits. When the switch is set to STDY, all exterior lights are illuminated continuously, provided the associated light switches are turned on. Setting the master switch to FLASH permits the wing tip position lights and white tail position light to flash alternately with the fuselage lights and the yellow tail position light. The CODE position is used in conjunction with the code selector switch to flash the fuselage lights in code automatically according to the letter selected. The MAN position permits manual signaling with the fuselage lights by operating the keying switch. Visual indication of the manually keyed signal is provided by a red indicator light adjacent to the keying switch on the control panel.

CODE SELECTOR SWITCH.

The code selector switch is located on the exterior lights control panel and is used to flash out in code on the fuselage lights any one of the 12 letters of the alphabet that is selected. It is used only when the master switch is set at CODE.

CODE KEY.

This key is located on the exterior lights control panel. When the master switch is set at MAN, code messages

can be tapped out on the fuselage lights by using this key, provided the fuselage lights selector switch is set to DIM or BRIGHT.

CODE KEY INDICATOR LIGHT.

The red indicator light on the exterior lights control panel flashes the signal being transmitted by the code key on the fuselage lights.

FUSELAGE LIGHTS.

The two fuselage lights are installed on the top and the bottom of the fuselage approximately midway between nose and tail. Each light contains a normal and a dimming lamp. The lights are controlled by the fuselage lights selector switch and the master switch.

FUSELAGE LIGHTS SELECTOR SWITCH.

The fuselage lights selector switch is a three position toggle switch located on the exterior lights control panel. It can be set to BRIGHT, DIM or OFF. When the master switch is set to STDY and the fuselage light selector switch is set to DIM or BRIGHT, the fuselage lights will glow continuously. When the master switch is set to FLASH and the fuselage lights selector switch is set to DIM or BRIGHT, the fuselage lights and the yellow tail position light will flash alternately with the wing position lights and white tail position light. When the master switch is set to CODE, the fuselage lights will automatically signal in code the letter selected on the code selector switch. If the master switch is set to MAN, the fuselage lights will operate in conjunction with the code key for manual signaling purposes.

WING POSITION LIGHTS.

The recessed type wing position lights are located on the leading edge of each wing tip. The right wing position light cover is green and the left is red. These lights are controlled by the wing position light selector switch and the master switch located on the exterior lights control panel.

WING POSITION LIGHTS SELECTOR SWITCH.

This three position toggle switch, which can be set to BRIGHT, DIM or OFF, is located on the exterior lights control panel. When the master switch is set to MAN, CODE, or STDY and the selector switch is set to DIM or BRIGHT, the wing position lights will glow continuously. The wing position lights and the white tail position light will flash alternately with the fuselage lights and yellow tail position light when the master switch is set to FLASH.

TAIL POSITION LIGHTS.

The tail position lights are installed on the end of the tail fairing. The upper light is fitted with a yellow cover; the lower with a white cover. These lights are controlled by the tail position selector switch and the master switch.

TAIL POSITION LIGHTS SELECTOR SWITCH.

This toggle switch can be set at any of three positions, BRIGHT, DIM or OFF, and is on the exterior lights control panel. When the tail position lights selector switch is set to BRIGHT or DIM, the tail position lights will glow continuously if the master switch is set to MAN, CODE or STDY. If the master switch is set to FLASH, the yellow tail position and fuselage lights will flash alternately with the white tail position and wing position lights.

FORMATION LIGHTS.

A blue formation light is located on the underside of each outboard wing panel near the tip. The lights are controlled by the four positions of the master switch and by the formation light selector switch.

FORMATION LIGHT SELECTOR SWITCH.

The formation light control is a three position toggle switch on the exterior lights control panel with BRIGHT, DIM and OFF positions. The formation lights, will glow continuously when the master switch is set to MAN, CODE, STDY or FLASH and the formation light switch is set to BRIGHT or DIM.

### INTERIOR LIGHTING SYSTEM.

The interior lighting system consists of individually lighted instruments and switches on the instrument panel, certain edge lighted console control panels, and two hooded lights on the left side of the cabin and two on the right side to illuminate the consoles. In addition, an emergency instrument floodlight is installed on the upper center portion of the instrument panel (17, figure 1-4) which is controlled by a switch mounted below it. Power is supplied from the main bus and circuits are protected by two circuit breakers on the main circuit breaker panel (1, figure 1-5) and two fuses mounted on the fuse panel (11, figure 1-5). The interior lighting system is controlled by two rheostats (8, figure 1-5) on the right console.

INTERIOR LIGHTS CONTROL SWITCHES.

The instrument lighting is controlled by a combination on-off switch and rheostat mounted on the right console. The edge lighted console control panels and console lights are controlled by a rheostat identical to the instrument lighting switch and mounted adjacent to it. Turning the rheostats clockwise from OFF turns on the respective lights and provides a range of adjustment from dim to bright.

EMERGENCY INSTRUMENT LIGHT SWITCH.

This ON-OFF toggle switch is mounted beneath the emergency instrument floodlight on the upper center portion of the instrument panel (17, figure 1-4). Setting it to ON provides emergency instrument panel lighting in the event of normal instrument light failure.

SPARE LAMPS.

Spare lamps are mounted on a panel on the right console (3, figure 1-5).

## OXYGEN SYSTEM.

### DESCRIPTION.

Two 514 cu in. capacity, shatter-proof oxygen cylinders are installed in brackets on the bulkhead aft of the

cabin. The cylinder valves are opened when connected to the line coupling, and flow is controlled by the regulator. The diluter-demand pressure breathing regulator, with oxygen supply shut-off valve, diluter valve control, flow indicator and system pressure gage, is installed on the left console forward of the throttle quadrant. The feed tube from the regulator runs to a personal gear composite disconnect on the aft end of the console, and a face mask attaches to the tube from the assembly (4, 19, figure 1-3).

### OXYGEN REGULATOR OPERATION.

The automatic pressure breathing diluter-demand regulator is designed to meet the demands of the inhalation phase of the breathing cycle and deliver either a properly proportioned mixture of air and oxygen or 100% oxygen, dependent upon the setting of the adjustable diluter valve lever. With the diluter valve set to the NORMAL OXYGEN position, air is drawn into the breathing system and is automatically mixed with oxygen from the supply cylinder to give the total needed oxygen required up to approximately 30000 feet, beyond which 100% oxygen is delivered. With the diluter valve set to the 100% OXYGEN position, 100% oxygen is delivered at all altitudes. Above 35000 feet cabin pressure, the regulator automatically delivers to the mask the required positive pressures of oxygen for operational flights up to an equivalent cabin pressure of 43000 feet, and may be used for short periods of time at an ambient pressure of 45000 feet. In addition, sufficient pressure is delivered automatically for emergency descent from 50000 feet in the event that pressurization is lost and the cabin pressure is reduced to that of the surrounding air. With the diluter valve set to the NORMAL OXYGEN position, a relatively small inhalation suction (one inch of water suction) is sufficient to deliver a flow of 150 liters of oxygen per minute. This characteristic assures the user an adequate oxygen flow and ease of breathing. The regulator is attached directly to the high pressure oxygen supply through tubing connected to the cylinders. The pressure in the cylinders may decrease from 1800 psi to 50 psi without affecting the normal operation of the regulator.

### OXYGEN PREFLIGHT CHECK.

The following items shall be checked prior to a flight in which oxygen is to be used or is likely to be used, in order to assure proper functioning of the system:

a. After the oxygen supply control at the regulator has been turned on, oxygen supply cylinder pressure should read 1800 to 1850 psi if the cylinders are fully charged. If the cylinder pressure has decreased by more than 25 pounds in 24 hours, the leakage is excessive and the system should be subjected to ground crew test prior to use.

b. To test the breathing tube couplings, regulator diaphragm, and diluter check valve for leakage, insert a spare mask tube quick disconnect fitting into the open end of the disconnect. Blow into the open end of the disconnect until the flow indicator face opens. Seal the end of the disconnect with the tongue. If the flow indicator does not close within five seconds the leakage is within acceptable limits. If leakage exists, check the couplings, outlet elbow and breathing tube hose clamps for tightness.

c. Put on mask. Check mask fit by placing the thumb over the disconnect at the end of the breathing tube and inhaling lightly. The thumb must be removed from the disconnect after each continuous inhalation. If there is no leakage and the mask adheres to the face

## OXYGEN DURATION

| CABIN PRESSURE ALTITUDE | Hours Using Diluted Oxygen | Hours Using 100 % Oxygen |
|---|---|---|
| 30000 feet | 6.2 | 6 |
| 25000 feet | 8 | 4.6 |
| 20000 feet | 13.8 | 3.8 |
| 15000 feet | 17 | 2.9 |
| 10000 feet | 18.5 | 2.4 |
| 5000 feet | 15 | 1.9 |

*Note*

Duration data should be used as a guide only, since oxygen consumption varies with the individual

*Figure 4-3. Oxygen Duration Table*

tightly, a definite resistance to inhalation will be encountered. If the mask leaks, tighten the mask suspension straps.

**WARNING**

Do not use a mask that leaks.

d. Fully engage mating portion of the disconnect coupling to connect mask to the oxygen system breathing tube.

e. Attach clip of breathing tube to proximate strap of shoulder harness sufficiently high on the chest to permit free movement of the head without stretching the mask tube.

f. Breathe several times and observe flow indicator for blink, verifying the positive flow of oxygen.

### OXYGEN SYSTEM OPERATING INSTRUCTIONS.

a. Oxygen shall be used constantly during day flights when above 10000 feet and during night flights when above 5000 feet and when on combat missions and training missions simulating combat.

b. After making certain that oxygen supply control lever is turned to open supply to regulator, see that pressure gage reads approximately 1800 psi for fully charged cylinders.

c. Set diluter valve to NORMAL OXYGEN for normal flight conditions. Only when the presence of carbon monoxide or other noxious gases (such as fumes) is suspected, should diluter valve be set to 100% OXYGEN.

d. Put on the oxygen mask, fully engaging disconnect coupling. Attach clip of breathing tube to proximate strap of shoulder harness sufficiently high on the chest to permit free movement of the head without stretching the mask tube.

e. To check mask fit during flight, turn the safety pressure control to PRESSURE ON. Take a deep breath and hold breath. Note position of the oxygen flow indicator. If flow indicator opens (i.e., all black), excessive leakage is indicated. Tighten mask straps until flow indicator closes (i.e., white face shows), indicating that a leak-tight mask seal has been obtained. The characteristics of the flow indicator are such that this test cannot be conducted at pressure breathing altitudes; however, the outward flow of oxygen into the eyes from a leaking mask is readily detectable and is an equally sensitive test.

**CAUTION**

At high altitude, after pressure surge following loss of cabin pressurization, check mask for leak-tight seal.

f. Breathe normally.

g. Check cylinder pressure gage frequently for amount of oxygen remaining.

h. Check oxygen flow indicator frequently for flow of oxygen through the regulator. The oxygen flow indicator operates upon the intermittent application of from five to seven inches of water pressure created by the flow of oxygen. The automatic pressure breathing oxygen regulator delivers a pressure of five to seven inches of water to the mask at approximately 41000 feet and this pressure is likewise transmitted to the oxygen flow indicator, which will remain open as long as this pressure is applied. Accordingly, the flow the positive pressure in the mask is an unmistakable indication that oxygen is being delivered to the mask and no apprehension should be felt as long as the flow indicator remains open.

**Note**

Do not exhaust supply cylinders below 300 psi except in an emergency.

### OXYGEN SYSTEM EMERGENCY OPERATION.

Should symptoms occur suggestive of the onset of anoxia, immediately turn the safety pressure control on the rim of the regulator to PRESSURE ON and descend below 10000 feet.

**WARNING**

If regulator becomes inoperative in flight, activate the emergency oxygen equipment, and descent below 10000 feet.

Whenever excessive carbon monoxide or any other noxious or irritating gas is present or suspected, the diluter valve should be set at 100% OXYGEN, regardless of the altitude, and undiluted oxygen used until danger is past or the flight completed. Should brief removal of the mask from the face be necessary at high altitudes, use the following procedure:

a. Take three or four deep breaths of undiluted oxygen (diluter valve set at 100% OXYGEN).

b. Hold breath and remove mask from face.

c. As soon as practicable, replace mask to face and take three or four deep breaths of undiluted oxygen.

d. Reset diluter valve to NORMAL OXYGEN.

Above 35000 feet cabin altitude, the regulator automatically delivers to the mask the required positive pressures of oxygen for operational flights up to an equivalent cabin pressure of 43000 feet and may be used for short periods of time at an equivalent cabin pressure of 45000 feet. In addition, sufficient pressure is delivered automatically for emergency descent from 50000 feet in the event that pressurization is lost and the cabin pressure is reduced to that of the surrounding air.

## NAVIGATION EQUIPMENT.

### ELECTRONIC NAVIGATION EQUIPMENT.

RADIO COMPASS AND HOMING EQUIPMENT.

See applicable paragraphs under Electronic Equipment.

**NAVIGATION INSTRUMENTS.**

STAND-BY COMPASS.

See Instruments paragraph, Section I.

G-2 COMPASS.

See Instruments paragraph Section I, for description.

OPERATION.

a. Set battery switch to BAT. & GEN.

b. Allow sufficient time for the gyro motor to warm up, then set control switch to COMPASS CONTROL.

c. Push in and rotate caging knob to establish initial "on course" heading obtained from correspondence indicator, then pull out knob. The instrument will now correct any deviation from the magnetic heading, as shown by the correspondence indicator, at a rate of four degrees per minute.

**CAUTION**

To insure proper alignment of the gyro element, it is important that the knob be held firmly against the cover flange while it is being rotated and also for a few seconds after the correct setting has been made. Release the knob straight out—with no twisting movement.

d. When operating near polar regions or on a carrier deck, the instrument should be used as a free directional gyro; to so use, set control switch to FREE DG.

e. To return to compass controlled operation from a free directional gyro, set control switch to COMPASS CONTROL, then push in caging knob and reset master direction indicator to heading indicated by correspondence indicator.

**CAUTION**

Always operate the selector switch before setting the heading with the caging knob, otherwise the instrument will be damaged.

If the difference between the correspondence indicator reading and the gyro reading is great, several minutes will be required before complete correction of the instrument will take place. To eliminate this delay, the gyro and correspondence indicator may be synchronized by turning the caging knob. Caging is not required during maneuvers.

## ARMAMENT.

**Note**

The LABS angle selector switch on the armament switch panel mounted on the windshield deck, the LABS position on the station selector switch, the LABS start switch on the left console, and two warning lights labeled LABS IND. and TO, mounted on the left side of the sight unit, and the MAN Y/R switch on the left cabin rail, are utilized only when Special Weapon provisions are installed.

Four M-3 20mm guns are installed in the fuselage nose. Ammunition is loaded in four ammunition boxes connected to the guns by feed chutes. An Aero 5A armament control system is installed and a gun camera is mounted on the windshield deck. Armor plate is installed on the bulkhead forward of the pilot's seat and on the sloping bulkhead aft of the seat. The bullet resistant glass windshield is mounted in a heavy plate frame.

**Note**

On flights in which no ammunition, or ammunition for only two guns is loaded, ballast must be installed in order to maintain airplane cg within the aft limit at low fuel loads. This ballast is provided for the airplane by the contractor and is stowed in the forward (inboard guns) ammunition boxes. On flights in which full ammunition for all guns is loaded, the cases and links from fired rounds are retained in the nose shell, thereby maintaining the cg within proper limits.

**GUN CONTROLS.**

The trigger switch (14, figure 1-6) is on the front of the stick grip. The four gun chargers are controlled by a four way, solenoid operated valve and pressure switches which, in turn, are controlled by two toggle switches on the armament switch panel located on the windshield deck to the left of the sight unit. These gun charging switches control the inboard and outboard guns and have positions marked READY, OFF and SAFE. The armament master toggle switch breaker (5, figure 1-4), is outboard of the other switches on the armament switch panel.

ARMAMENT CONTROL PANEL.

An armament control panel (18, figure 1-3) is installed on the left console. This panel contains a two position gun and rocket selector switch marked GUNS and ROCKETS, a two position dive angle selector switch marked 35° & OVER and 35° & UNDER, a three position rocket arming switch marked ARMING NOSE & TAIL, SAFE, and TAIL ONLY, a LABS start switch, and a four position, rotary type rack selector switch marked LEFT, RIGHT, BOTH, and LABS (see note under Armament paragraph).

**GUN CONTROLS OPERATION.**

READY SETTING.

When either the inboard or outboard guns are selected for firing, set the master switch to ON, set the applicable gun charging switch to READY. The fluid on the forward side of the piston in the cylinders will return to the reservoir and the gun charger piston will return to the battery position, rendering the guns ready for firing.

SAFE SETTING.

When either gun charging switch is set to SAFE, the respective breechblocks are moved automatically from battery to recoil and are retained in the recoil position by the sear and charger action so that the trigger con-

trols will not operate even if the trigger is depressed. Moving the master switch to OFF will also render the guns safe. The breechblocks will remain in recoil, preventing firing, until (with the master switch ON) either switch is set to READY, which releases the hydraulic pressure and permits the charger piston to return to the battery position and permits firing if the trigger button is pressed.

### GUN OPERATING PROCEDURE.

a. Set armament master switch to ON.

b. Set selected gun charging (outboard, inboard, or both) switch to READY for firing.

c. Press trigger button on stick grip.

d. After firing, return gun charging switch, or switches, to SAFE.

**Note**

To operate the guns for ground check, the disabling switch must be set by the ground crew to energize the gun circuit, which is normally broken when the landing gear control handle is at DOWN.

In order to insure that the gun charger lug has fully returned to the battery position prior to actuating the trigger button for firing of the guns, the electrical circuit between the trigger button and the gun-firing solenoid remains open until the hydraulic pressure in the gun charging cylinder drops to the low pressure setting on the pressure switch. At high altitudes where the temperature is $-40°C$ ($-40°F$) or lower, it takes about three seconds to close the circuit to the gun firing solenoid. Whenever the pilot presses the trigger button after actuation of the gun charging switch to READY and the guns fail to fire, it may be an indication that the charger lug has not returned to battery position. If such is the case, keeping the button depressed for several seconds will allow the charger lug to return to battery position and start firing of guns.

**WARNING**

The guns will be operative when gun charging switch is set to READY with the master switch set to ON.

### ARMAMENT CONTROL SYSTEM—AERO 5A.

The ACS Aero 5A comprises a sight unit MK 8 Mod 0 (a part of AFCS MK 6 Mod 0), mounted on a bracket on the cowl center line (16, figure 1-4); an Aero 2C gunsight controller, located below the sight; a MK 20 Mod 0 control box on the left console (6, figure 1-3); an Aero 4C ranging control (the throttle grip) (34, figure 1-3); a MK 7 Mod 0 relay box; a radar range servo Aero 1A and an Automatic-Range-Only (ARO) radar set AN APG-30. The radar set control is located on the left console (8, figure 1-3) adjacent to the MK 20 Mod 0 control, and the tracking indicator is mounted on a bracket (18, figure 1-4) attached to the sight unit MK 8 Mod 0. This unit contains a red tracking indicator light, a range meter and an automatic frequency control meter. The red tracking indicator light will flash on while the radar is searching for a target or is radiating signals that might be detected by enemy countermeasures, and will go out when the radar has locked on a target. The range meter indicates the range of the target in feet, and the automatic frequency control meter measures crystal current in milliamperes. The latter instrument is used to check that the system is operating properly.

**CAUTION**

The RANGE and AFC meter dials have been rotated 90 degrees from the normal positions to eliminate magnetic interference with the stand-by compass.

With this system, the pilot's problem is simplified to one of aiming the airplane so that the gyro reticle image remains on the target, and following the sight line to the target until the attack has been completed. Radar set AN/APG-30 is designed for use only in air-to-air tactics.

SYSTEM CHECK.

a. Set battery switch to BAT. & GEN.

b. Set power switch on radar set control to STDY MAN.

**Note**

Placing the radar in STDY MAN. permits it to warm up and also permits manual ranging of the fire control system.

c. Rotate selector switch on MK 20 Mod 0 control to GYRO. The gyro motor should then start to run, and the gyro reticle image should appear on the reflector plate of the sight unit. The image should stabilize quickly and be clearly defined.

d. Rotate the selector switch to FIXED & GYRO and note that the fixed image of the sight unit is visible.

e. Rotate dimmer control knob on the MK 20 Mod 0 control from DIM to BRIGHT, noting that the dimmer control varies the intensity of the images continuously over the entire range.

f. Rotate the selector switch to the FIXED position. The gyro image should then disappear and the gyro motor come to a gradual stop.

g. Return the selector switch to the FIXED & GYRO position and rotate the throttle grip (ranging control) to its counterclockwise stop, then hold. The range scale in the sight unit should indicate 600 feet.

h. Note diameter of circle formed by the diamond-shaped pips of the gyro image, then rotate throttle grip full clockwise. The range scale in the sight unit should now indicate 2400 feet and the diameter of the circle should be smaller.

**Note**

Step i. below applies only if AN/APG-30 radar equipment is not being used.

i. Move the target span handle on the sight unit from right to left toward the higher setting on the span scale. The diamond-shaped pips should then move out from the center pip of the gyro image. The sight line through the center pip of the gyro reticle should be the same as that through the fixed reticle.

j. Set the guns and rockets selector switch to GUNS.

k. Sight on a distant object. Both the fixed and gyro images should appear to coincide on the object. Rotate ranging throttle grip from maximum to minimum range. The center pip of the gyro image should remain stationary. A slight vertical movement of the center pip may be found in some sight units when range is changed from maximum to minimum. This is acceptable if the total movement does not exceed four mils (this may be estimated by comparison with the ten mil arcs of the fixed images), and if the center pip coincides with the center of the fixed cross at some range between maximum and minimum.

l. Set the guns and rockets selector switch to ROCKETS.

m. Set the dive angle switch to 35° & UNDER. The center pip of the gyro image should move to a point which corresponds to the offset value specified for rocket dive angles from 15 to 35 degrees. The ten mil arcs of the fixed image may be used to gage the amount of offset from the center of the fixed cross.

n. Set the dive angle switch to 35° & OVER. The center pip should move to a point which corresponds to the offset value for rocket dive angles from 35 to 60 degrees. Check the caging circuit by changing the position of the dive angle switch while watching the pip. With the caging switch closed (throttle grip at extreme maximum range position), the pip should move to its new position. With the caging switch open, the movement should be slow.

o. If the flight is to begin immediately, leave the selector at the FIXED & GYRO setting; otherwise, return the switch to the OFF position.

p. When the AFC meter on the tracking indicator stops sweeping and drops to zero, place the power switch on the radar control panel to ON. The AFC meter will jump to a reading between 0.5 and 1.0 ma and will hold steady. The tracking indicator will flash on while the radar is searching a target in range, and will go out when the radar has locked on a target.

**Note**

When the power switch on the radar control panel is set to STDBY MAN. during warm-up (approximately four minutes), the RANGE meter on the tracking indicator will sweep and the AFC meter will jitter. After warm-up is completed, there should be no movement on the RANGE or AFC meters. The AFC meter should indicate crystal current from 0.5 to 1.0 ma, with 0.7 ma desired. When the power switch is set to ON, the RANGE meter will sweep until locked on a target. When locked on, the meter will indicate range in feet.

The radar will lock on the nearest target within its range and show distance to the target, up to 2400 feet, on the sight unit range scale and up to 12000 feet on the tracking indicator. Depressing the range gates switch to GATES OUT will cause the radar to unlock from this target and select another target farther away. If no other target is within the maximum range of the radar, it will sweep its limit and again select the closest target within its range. Also note movement of the diamond-shaped pips as targets at different ranges are selected.

**Note**

The radar range exceeds the sight unit range; therefore, the range scale on the sight unit will indicate 2400 feet for all targets beyond this range. Range meter on tracking indicator will indicate target range continuously.

FLIGHT ADJUSTMENTS.

To use the system accurately and most effectively at the beginning of the flight, proceed as follows:

a. Set power switch on radar control panel to STDBY MAN.

b. On MK 20 Mod 0 control, turn selector switch to FIXED & GYRO if desired to see both image patterns; however, if they are confusing, setting selector switch to GYRO will eliminate the fixed image, or the outer markings of the fixed image can be blanked out by pushing the masking lever forward.

c. Adjust dimmer control knob on MK 20 Mod 0 control until reticle image is at desired brilliance.

d. As soon as the target is sighted, turn power switch on radar control panel to ON. If AN/APG-30 radar equipment is not being used, set the target span into the sight unit with the span setting handle (power switch on radar control panel in STDBY MAN). This setting will be a selected dimension of the target airplane, usually its wing span in feet.

**WARNING**

When no target is in view, keep the power switch in STDBY MAN. Otherwise, radiation of the radar transmitter may give your position away to enemy countermeasures.

**Note**

Adjustment of target span handle is required only when manual ranging is used.

e. Since the ACS Aero 5A does not compensate for gravity drop, it is necessary to make an allowance of about 16 feet (7 mils) at 2400 feet range, decreasing to about one foot (2 mils) at 600 feet.

**Note**

The maximum range control on the radar control panel is used to adjust the maximum range of the radar. The proper setting of this control will depend on the altitude of the airplane and should be adjusted so that the radar will not lock on ground reflections.

With control set at minimum, the radar range will still be more than the sight unit range. In normal operation at altitudes over 10000 feet, the maximum range control may be left at the full clockwise position to allow locking on a target at maximum range.

When there is more than one target close to the radar line of sight, the desired target may be selected by operating the range gates switch to GATES OUT and noting the change in range shown on the tracking indicator. When the targets are within range of the sight unit (2400 feet), note the change in diameter of the diamond-shaped pips.

Commence tracking by maneuvering the airplane to bring the center pip exactly above the target by an amount necessary to compensate for gravity drop.

When Aircraft Armament Change No. 77 is accomplished on the Radar Range Aero 1A, the pilot may uncage the gyro in the sight unit any time he desires to do so, independent of radar lock-on, by rotating the throttle grip at least 20 degrees out of its detent position. This rotation of the throttle grip when using radar ranging in no way affects the range being fed to the sight unit from the radar. All it does is to uncage the sight unit at the pilot's discretion. The pilot should uncage as soon as possible and establish smooth tracking on the target. The radar will probably lock on in excess of 7000 feet. The sight unit will have a 2400 foot sensitivity from the time of uncaging to 2400 feet. When the range decreases to 2400 feet, the sight will already have solved for the proper lead angle if tracking is commenced at least one second before reaching 2400 feet. The red light in the tracking indicator will go out when the radar is locked on the target. If the pilot should forget to uncage the sight unit before reaching 2400 feet, the sight unit will automatically uncage at 2400 feet. However, in this case, one second of tracking will be necessary before the sight unit generates the proper lead angle. It is therefore always advantageous to uncage the sight unit at least one second before reaching 2400 foot range.

When diamond-shaped pips in the sight unit begin to expand, the range is 2400 feet. Firing may be commenced at this point. When the range decreases to 600 feet the diamond-shaped pips will cease to expand. Since the sight unit will not compute the proper lead below 600 feet, pull-out should commence at or before this point. In addition, the AN/APG-30 radar will probably lose its lock-on at a range of about 500 feet. When this occurs, the sight unit diamond-shaped pips will contract to the 800 yard point. The sight unit will no longer be computing the proper lead.

f. Manual ranging may be selected by turning the power switch on the radar control panel to STDBY MAN. After setting the estimated wing span of the target, in feet, into the sight unit by moving the target span lever to the appropriate number, track during the run by continuously rotating the throttle grip, so as to keep the extreme tips of the target framed by the imaginary circle formed by the inner points of the pips of the gyro reticle image.

**Note**

On the average airplane, the distance from the junction of the wing root to the end of the tail of the target is half a wing span. At 90 degrees off the tail of the target, ranging is accomplished by keeping the inside tip of one of the pips on the end of the tail of the target and the center pip of the reticle pattern just above the wing root fuselage junction.

During manual ranging, the gyro will remain caged as long as the throttle grip is at the maximum range position (fully clockwise). If tracking is to be started before the target is within range, uncage the gyro by rotating the control slightly counterclockwise.

g. Continue smooth tracking and ranging throughout the attack.

**Note**

In order to prevent the sight unit gyro from tumbling, it is recommended that the gyro be caged at all times except when tracking and ranging a target.

### GUN CAMERA.

The gun camera is mounted on a bracket on the windshield deck, forward of the sight unit. Operation is controlled by the armament master switch and the trigger switch on the stick grip. When the guns are fired, the camera operates. The camera may be operated without firing the guns by placing the gun charging switches in either the OFF or SAFE position and depressing the trigger switch, or by use of a test switch located on the windshield deck. The gun camera may also be operated when rockets are fired.

## "G" SUIT EQUIPMENT.

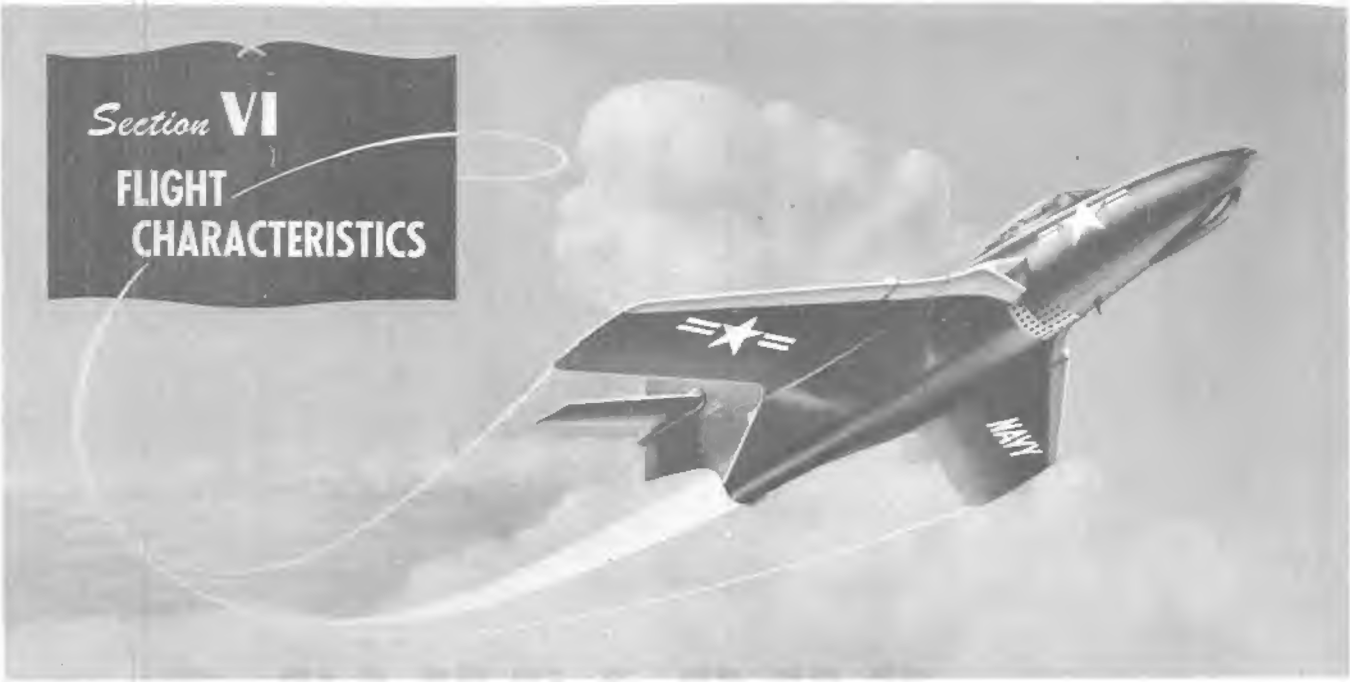
The "G" suit tube is in the personal gear composite disconnect, aft on the left console. The "G" valve, outboard of the tube, has a selective feature which permits pilot selection of either high or low "G" suit inflation pressure as individual pilot requirements dictate. Rotate valve cap counterclockwise for a high suit inflation pressure and clockwise for low suit inflation pressure. On the top of the valve cap is a button which can be manually depressed to inflate the "G" suit at any time for checking valve operation or to reduce pilot fatigue (1, figure 1-3).

## MISCELLANEOUS.

The map case is located at the aft end of the right console under the cabin rail. A relief tube is provided and the personal gear composite disconnect with connections for oxygen, "G" suit, and radio leads, is installed on the left console. An anti-glare shield is stowed in the map case.

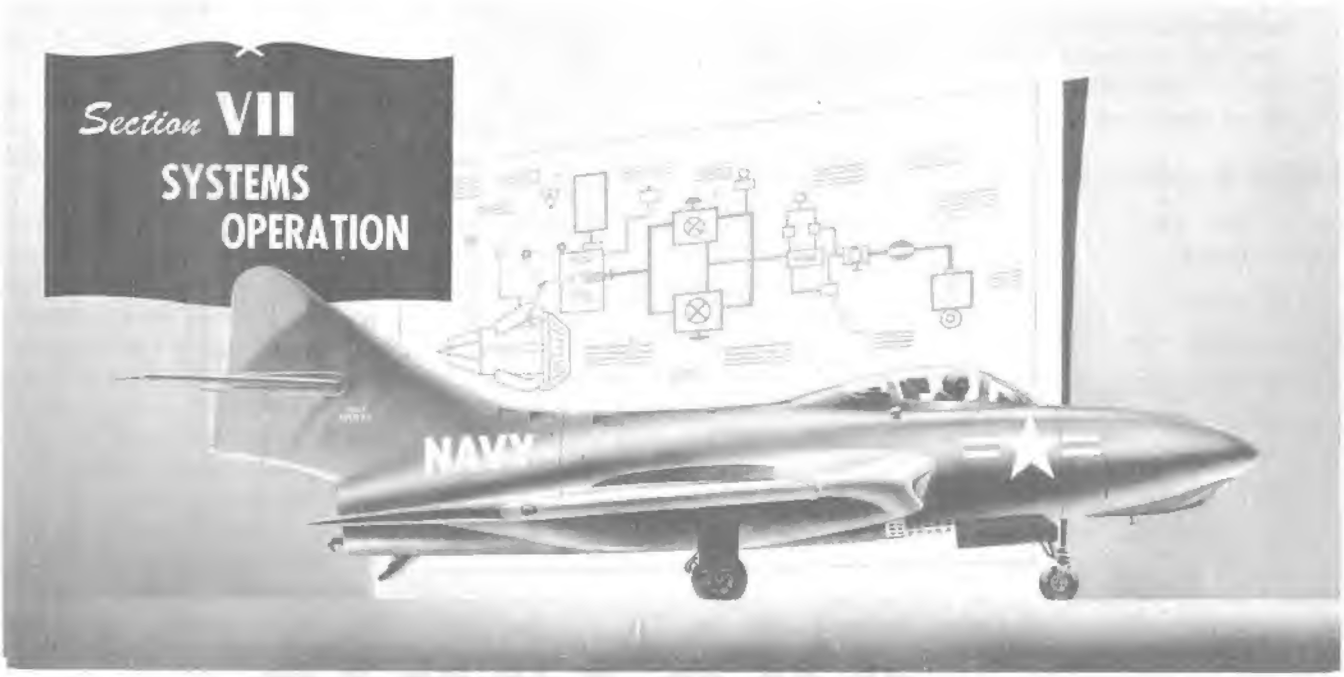

SEE CONFIDENTIAL SUPPLEMENT

CO 01-85FGF-1A




SEE CONFIDENTIAL SUPPLEMENT

CO 01-85FGF-1A




## ENGINE OPERATION—GENERAL FLYING.

Tailpipe temperature control is of the utmost importance to the life of the engine; therefore, it is essential that the limiting temperature for any given condition not be exceeded. When operating with the primary (normal) fuel system, the following characteristics are present:

a. After making an increase in power setting, the full tailpipe temperature increase may lag. After the initial increase is noted, the temperature may continue to increase slowly for as long as five minutes. The stabilized temperature should be within limits established for the various power conditions. (See figure 5-3.)

**CAUTION**

Normal acceleration temperature must never exceed 800°C (1470°F).
Avoid prolonged operation between 68 and 76% rpm except in emergencies.

b. Rapid deceleration may be made without flame-outs.

c. The engine fuel control unit provides compensation to maintain, within close limits, any selected engine speed throughout broad ranges of altitude and airspeed.

## ENGINE MALFUNCTIONING.

If, during take-off, flight or landing, malfunctioning of the primary fuel control system should occur, as evidenced by a dropping off of power and or a falling off of rpm, the engine fuel system selector switch should be set to transfer control to the emergency system. The rpm should then increase to a safe flight value, limited by the topping governors in the fuel pumps. If rpm exceeds that required for take-off, it should be reduced immediately to the take-off value by the use of the throttle. After the transfer, throttle sensitivity will be similar to that when operating on the primary system at sea level, except there will be no automatic acceleration or deceleration control. Accelerations must be made carefully to avoid excessive tailpipe temperatures due to overfueling. As altitude increases, engine speed for a given throttle movement will increase markedly. If conditions should permit returning operation to the primary fuel control, it may be accomplished by setting the engine fuel system selector switch momentarily to RESET PRIMARY and then to START & PRIMARY.

**CAUTION**

When operating on the emergency fuel system, check tailpipe temperatures carefully.

The emergency fuel system may be used at any time during flight by setting the engine fuel system selector switch to EMER. Except under take-off conditions, the throttle must be retarded to IDLE prior to switch-over to prevent overfueling and possible flame-out. It is also desirable to make transfers from the emergency to the primary fuel system with the throttle at IDLE.

**CAUTION**

Operation on the emergency fuel system places severe requirements on the main pumps; therefore, the emergency fuel system should not be used for extended periods of operation except under actual emergency conditions.

## ENGINE ACCELERATING CONDITIONS.

At sea level the times required for engine acceleration are as follows:

| | |
|---|---|
| Idle to 100% | 8 seconds |
| 65 to 100% rpm | 5 seconds |
| 85 to 100% rpm | 3 seconds |

Certain engine acceleration characteristics which may be experienced during high altitude operation are discussed below.

a. In performance of snap or maximum rate accelerations at high altitude, around 40000 feet, the ideal control setting produces a smooth acceleration throughout the entire engine speed range. However, with the average control setting, some engine roughness is to be expected during the acceleration condition at altitudes above 30000 feet but, up to a point, should not be the cause of undue concern.

b. As control settings become richer, rough operation ranges become apparent. As richness is increased further, the roughness becomes increasingly severe and extends over slightly wider engine speed ranges until the point of rich flame-out is reached. This roughness would be expected to be most severe in the 90-95% rpm range, although another roughness range is sometimes noted at approximately 85% rpm.

c. A setting that causes roughness which comes in and then fades out through the above stated speed ranges without changing noticeably in frequency and rate of engine speed increase is acceptable. With this condition, the throttle can be handled in any manner over any engine speed range without concern for flame-out. This roughness can be described as a buzz of fairly high frequency and is more heard than felt.

d. Warning of an approaching flame-out from an overrich control manifests itself in the form of a decrease in frequency and an increase in severity of roughness during the acceleration, together with a slowing, sometimes to zero, of the rate of engine speed rise. The tailpipe temperature is not necessarily affected; it may hold fairly steady or, more likely, tend to drop. As the flame-out is approached, the roughness can be described as changing from a buzz to a heavy stutter, together with a slowing or stopping of the acceleration rate. This condition occurs very close to the flame-out point and, if reached, the throttle should be retarded immediately to some intermediate point to prevent flame-out.

e. It has been found in accelerating from intermediate rpm settings, rather than from idle, that roughness will sometimes be more severe than through the same engine speed during snap acceleration from idle. Identification of proximity to flame-out and the remedial action for this condition is the same as above.

f. A decrease in the rate of advance of the throttle will decrease the tendency for flame-out from an overrich control setting and will decrease the severity of an acceleration roughness. Decreasing airplane's altitude has the same effect.

# Section VIII
## CREW DUTIES

NOT APPLICABLE TO THIS AIRPLANE

# Section IX
# ALL WEATHER OPERATION

TO BE SUPPLIED WHEN AVAILABLE


SEE CONFIDENTIAL SUPPLEMENT

CO 01-85FGF-1A